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CHARACTERIZATION OF AIR FORCE TRAINING AND COMPUTER-BASED TRAINING SYSTEMS

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This paper has been reviewed and is approved for publication.

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This paper documents the approach used in the development of guidelines designed to aid novice training managers in the computer-based training (CBT) system planning, selection and implementation process. Phase I developed a list of critical factors that characterized Air Force training organizations and CBT technologies. These factors were developed at a level simple enough so misinterpretation by novice managers was minimized. Next, decision processes were merged with identified factors forming guidelines that followed an input-process-output model. These preliminary guidelines were field-tested during Phase II at four Air Force training organizations. Concurrent with field-testing, the guidelines were validated by convening a panel of Air Force CBT "experts" to critique the guidelines and compare their CBT development processes with those of the guidelines. Following these efforts, the guidelines were revised and refined.

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TABLE OF CONTENTS

PREFACE

This project forms a part of a larger piece of research by Armstrong Laboratory concerning CBT. The goal of the research is to improve overall training within the USAF, and in particular in USAF schools. As a part of the continuing research, the Laboratory has investigated ways of improving instructional quality by providing tools and assistance to the staff of USAF training centers. This project makes a significant contribution to that effort.

For some time, Armstrong Laboratory has recognized the need for standardization of CBT planning, selection, and implementation procedures in the USAF. This task was undertaken along with others to provide research into the development of some tools which might be used to address the needs of organizations planning to implement CBT.

Special thanks are to be given to Captain Reynold Hioki, who provided invaluable assistance in making this project happen. Captain Hioki visited each of the test sites, prepared organization personnel to use the instrument, answered questions which arose during the tests, and provided assistance whenever needed to the participants in the study. He also coordinated the meetings of the expert panel, and provided them with all of the data they needed to do their work. Without his able assistance the results of the project would not have been successful

SUMMARY

The objective of this research was to determine those factors which are critical to USAF organizations which are planning, selecting, or implementing CBT. By determining critical instructional setting variables, an organization may be able to select a CBT technology which best matches its requirements. The approach taken was to develop a questionnaire and decision aid which could be used by USAF personnel and organizations inexperienced with computer-based training to categorize their training needs and evaluate CBT technologies in light of these needs. Factors considered are the various types of course objectives, student and staff needs, equipment compatibility, compatibility with other training organizations and courses, cost, and several other factors. A prototype instrument was developed which was aimed at performing many of the same functions as a CBT feasibility study. The instrument was tested on three typical USAF organizations, and the results compared to the recommendations of four USAF CBT consultants who were convened into an expert panel. The instrument was revised based on the results of tryouts and the comments of the CBT expert panel. The paper-based instrument is now ready for extensive operational testing with user commands, and eventual automation. The instrument provides USAF users with a systematic, organized way of planning, selecting, and implementing CBT in their organization.

CHARACTERIZATION OF AIR FORCE TRAINING AND COMPUTER-BASED TRAINING SYSTEMS

I. INTRODUCTION

Background

The use of computer-based training (CBT) technologies is widespread throughout the United States Air Force (USAF). When CBT has been properly planned for, and is implemented based on a sound plan, it can have a positive effect on both training effectiveness and efficiency. However, when CBT is not properly planned for, when an inappropriate CBT system is selected, or when a CBT implementation encounters problems, the results can be just the opposite. When improperly applied, CBT can potentially result in ineffective instruction resulting in substandard learning, or increased costs due to longer training times, courseware development problems, and logistics or maintenance problems. In addition, the inappropriate application of CBT can result in adverse impacts on a training organization's operating structure, functioning, and resources. Given the current state of planning for and selecting CBT systems, these problems do not manifest themselves until a CBT system is being developed or implemented.

In determining the appropriate media application for their training environment, USAF and other Department of Defense (DOD) users need to be able not only to select CBT from a group of other media alternatives, but also to select the most appropriate CBT system for their specific training needs. The selection of CBT should be made so that the users get the most powerful system for training, while the USAF has the benefit of a cost effective solution. Since the USAF currently has no standard procedures in effect to determine the use of CBT for instructional applications, the way in which CBT is selected and procured varies from command to command, and even within commands. Standardized procedures are needed to assist USAF and DOD agencies in planning, selecting, and procuring cost effective CBT systems that meet their current and projected training requirements.

Approach

Media selection models abound. Certainly, most media models provide detailed recommendations as to the most appropriate media to use in accomplishing a set of training requirements. However, as a group, media models do not normally assess an organization's ability to implement a particular medium. Certainly, no models make recommendations as to how to implement the instructional technology in the specific instance of the organization. Still further, little information is available to help assess an organization's ability to make use of CBT technology. What this report summarizes is the results of a study undertaken by Armstrong Laboratory to develop a means of advising inexperienced USAF users on whether a specific CBT technology is appropriate for the organization's training needs, and to provide guidelines which would serve to *hold the user's hand* through the CBT planning, selection, and implementation process.

Originally, the research task focused on determining the information required by an organization for proper CBT planning, selection and implementation. By identifying this information, we hoped that some linkage could be established with the most appropriate CBT technology, thereby streamlining the CBT selection process. The information requirements were integrally linked with the decisions which had to be made by training planners and managers when they considered the introduction of CBT into their organizations. At that point the focus shifted to the CBT decision process, including the information required to make it work. The results of that investigation are reported here. Ultimately, the goal of Armstrong Laboratory was to develop guidelines to aid managers and organizations inexperienced in planning for CBT. Put another way, the primary objective of the program was to develop a predictive instrument which would allow USAF organizations to match their training requirements and instructional setting environment with the applicable CBT system(s) which best suits them, and to assess the impact of such technology on the organization.

From the reactions of several USAF organizations which have been contacted, CBT planning, selection and implementation assistance is long overdue. Currently, organizations have few directives or guidance for implementing CBT. The Instructional Systems Development (ISD) model may work well in other areas, but when it comes to implementing CBT the model provides little specific guidance to USAF users. Furthermore, within the USAF there seems to be no model to follow in planning or selecting a CBT system. Many USAF organizations must either obtain the services of expert CBT consultants to help them in the CBT planning process, or rely on whatever in-house expertise they may have available to do the task for them. In both cases, there might be different results (given the same data), depending on who the consultant(s) or in-house experts are. Research has indicated that a lack of clear guidance for CBT planning, selection, and implementation can sometime result in hesitancy on the part of the organization to implement a CBT technology. Because of an organization's uncertainty as to what and how much of their curriculum can benefit from CBT, there may be a tendency to maintain the status quo. Even worse, some organizations may forge ahead blindly into the realm of CBT without the necessary knowledge of how CBT may impact the training requirements or the organization for better or for worse.

This paper describes how Armstrong Laboratory has set about solving some of the CBT planning, selection and implementation problems facing the USAF today. We also describe the methodology employed in developing guidelines to assist USAF users through these difficult problems. We also included some specific features of the CBT planning, selection, and implementation guidelines which resulted from the study. The instrument itself is currently available for further research and validation through Armstrong Laboratory, Human Resources Directorate (AL/HRTC). Although the instrument has been tested in the field, it cannot be considered final in any sense of the word, since there still remain areas of research to be explored in CBT planning, selection and implementation.

II. METHODOLOGY

The methodology used for this study consisted of the following major steps, each of which will be described in detail in this report:

- Determine the problem
- Develop the Instructional Setting Inventory (ISI)
- Develop the CBT Inventory
- Test the inventories
- Determine CBT decisions
- Validate the instrument with USAF users
- Validate the instrument with CBT experts

Determine the Problem

Initially, the researchers focused on potential solutions, i.e., an updated ISD model, various commercial CBT planning and selection programs, etc. The ISD guidance which is currently available to USAF users is general in nature, and there seemed to be no good reason to provide parallel guidance. Several commercial products available provide more detailed advice, but none of them is tailored to the USAF resident training environment. The researchers eventually concluded that generic guidelines would only be of minimal help to the users. While such documents are useful references for USAF users, only the more experienced among them can solve their CBT needs using such products alone. Certainly, many of these documents go a long way towards expanding the knowledge base of the users regarding CBT technologies. But none of these documents are specifically aimed at answering the difficult questions facing an organization which is contemplating implementing CBT. Nor are these products designed with the inexperienced user in mind. Many of these documents presuppose that the user knows quite a bit about CBT technology and its impact on the learning environment and the organization as a whole.

The researchers focused on the question: *What is the problem in USAF CBT planning, selection and implementation?* They relied on three sources of data to answer this question:

1. The opinions of USAF personnel who had recently implemented a CBT program at their command. This information helped determine what was done right and what was done wrong.

2. Intensive interviews with USAF personnel inexperienced in CBT planning, selection and implementation. This information helped determine what the inexperienced personnel might be expected to know or not know, and what that person might be able to do.

3. The researchers' own experience in planning, selecting and implementing CBT for USAF users. This information formed the basis for querying the users, and a knowledge base of CBT expertise.

In our opinion, what was really needed was to mirror the advice that a skilled consultant would provide to an organization which had little or no CBT technology experience.

Develop Instructional Setting Inventory

Looking at what an expert CBT consultant does in terms of an *Input-Process-Output* model, the research task is twofold: first to determine what data or *Input* the consultant uses in making his recommendations regarding CBT, and second, to model the *Process* which the consultant goes through in making his recommendation. The desired *Output* was known, or at least the form that the users wanted, namely a *Yes/No* recommendation regarding CBT and some advice on how to handle the various details if CBT were selected. Looking at the problem in terms of the *Input-Process-Output* model means that any system devised to help the typical USAF user has to gather and analyze the same kind of information that an expert CBT consultant would use in making his recommendations. The logical first step seemed to be to determine what type of information an expert CBT consultant needed to know about an organization and about CBT systems in general, in order to make his recommendations.

Several personnel on the staff for this project had performed such *consulting* work with USAF user organizations. These personnel were quite familiar with the types of questions which the managers of a training organization usually ask. They were also familiar with many of the constraints within which USAF organizations had to work. They also had a clear idea of what kind of information a training organization would have available or be able to get. From this starting point the researchers began by cataloging the information which they, as *CBT consultants*, would need in order to advise an organization regarding the implementation of CBT. The first objective in determining the information requirements for CBT planning, selection and implementation was to develop an ISI. The purpose of the ISI was to characterize USAF resident training school environments in as much detail as practical and usable. By using the ISI one could encompass the entire range of training center and school management, administration, training delivery, courseware development, logistics support, operations, and maintenance functions performed. By being able to fully describe the resident training school environment they would also be able to identify most of the critical decisions, key factors, variables, interactions, and information requirements needed to fully characterize and measure the instructional setting for the introduction of CBT. Prior experience had shown that each variable in an instructional setting could be critical to successful CBT implementation; therefore, the more exhaustive our list, the better it would be.

As a measurement instrument, the ISI had to capture data on an organization as it currently operates and does business. Since the research staff included personnel who had direct experience in USAF training center operations, it was relatively easy to identify what needed to be asked about current operations. Moreover, the ISI has to be able to characterize the organization's ability to adapt itself to CBT. This adjustment might require changes in administration, management, logistics support, or other organizational factors besides training delivery and day-to-day operations. Besides asking questions about what is currently taking place, the ISI has to be able to capture data which could be used for making predictions about the organization. This requirement necessitated that certain questions be inserted into the ISI which gathered information on the organization's desired goals and future intent. This information was, perhaps, the hardest part in constructing the ISI. Some of the staff felt that the ISI had to approach an organization's future intentions without biasing the respondents in favor of CBT; therefore, it shouldn't ask them anything about CBT directly. Ultimately, the approach

taken was very straightforward. The ISI asked the participants about the expectations they had for improving their organization by introducing CBT. It was felt that this minimized introducing any bias in favor of CBT, yet it still got the required information about the organization's future intentions.

Develop CBT Inventory

Just as the ISI was developed to characterize the USAF training center or school environment, a CBT Inventory was developed to allow USAF organizations to categorize the functions, allocations, capabilities, and performance of currently available CBT systems. Thus, in combination, the ISI and the CBT Inventory would allow a USAF organization to determine their organizational climate for CBT and to match their requirements with existing CBT system capabilities. The specifics of how to do that, namely what decisions regarding the organization and CBT had to be made, were yet to be developed.

There were differing opinions among the research staff as to how to *categorize* CBT systems. Some researchers thought it necessary to make an exhaustive comparison across vendor CBT systems. This database of vendor capabilities might parallel the kind of information that CBT expert consultants would have available to them in order to make their recommendations. However, others argued that it would not be advantageous for the CBT Inventory to be a catalog of current CBT systems. If the CBT Inventory were to take that form it would immediately *date* the instrument. If a single system were to change, the CBT Inventory's usefulness would be diminished. Rather, the problem was approached from another angle: *How could an organization's CBT requirements be described so that the organization could effectively evaluate various CBT technologies available to meet these requirements at any point in time, current or future*? The focus of the CBT Inventory was changed from the capabilities of CBT systems to defining the specific capabilities needed to meet the organization's training requirements. This approach also seemed to be much closer to what an expert CBT consultant would do in assessing an organization's requirements, i.e., determine the requirements and then use the requirements to evaluate available CBT systems. This approach would bring into play the necessity for the user organization to make its own judgments as to which path to take. The organization would be able to judge for itself which CBT system was the most advantageous for the organization. Cost and other factors would have to be taken into account by the user organization, but with some assistance as to how to weigh each factor in its decision.

Test Data Collection Instruments

Once the two inventories had been developed, they were tested with members of the target population at four separate organizations. The pilot test was performed to determine if the inventories were collecting the right data, to see if the required data was readily available at the participating organizations, and to ascertain that the questions could be answered by the participants without the assistance of someone outside the organization. Since the inventories asked some detailed questions about various components of the curriculum and the organization, it was determined that it might be necessary for some participating organizations to have several different people provide the needed input to answer some sections of the inventories. In

addition, the involvement of more than a single individual in the CBT planning and selection process was viewed as fostering an environment for successful implementation of CBT within the organization. This process would allow many people to *buy into* the CBT decision, and it also afforded the opportunity for the more creative individual(s) in an organization to *emerge*. These personnel have proven to be invaluable contributors to any CBT effort. The pilot testing provided us some useful information on both the content and format of the questions. Some of our test participants who had some CBT experience even went so far as to provide suggestions regarding topics they thought should be included which had previously been omitted. At the end of pilot testing, the instruments were revised to account for any problems or difficulties which were identified.

Determine CBT Decisions

The information required for proper CBT planning, selection, and implementation was integrally linked to the decisions which had to be made. At the start of the project the distinct linkage between many of the decisions was less obvious. For example, although it seemed logical to separate the decisions regarding hardware and authoring systems from decisions regarding authoring in house or obtaining contract assistance, it was soon determined that these decisions were quite dependent upon each other. Normally authoring system decisions include factors regarding ease of use. These factors are linked to the ability of the organization's staff to author, which is linked to the need to get authoring training for the staff, which is, in turn, linked to staff turnover, etc. Each decision which had to be made seemed to have some kind of impact on several others. Once it was clear that there would be little possibility of separating the decision process cleanly into two parts, the idea of assessing the organization's setting or climate for CBT separate from the kind of CBT system which would be suitable for it was dismissed. This conclusion was critical for the format of the eventual product. Instead of two separate instruments: one to assess the instructional setting, and another one to assess the capabilities of applicable CBT technologies, these instruments would have to be combined into a single instrument which would provide the required data. It also meant that the relationships among the various decisions would have to be determined, and these relationships integrated into a logical CBT planning and selection process which would allow the users of the instrument to reach the proper conclusions about CBT in a way that was *transparent* to the user.

The approach taken in determining the decisions which needed to be made by an organization consisted of two parts. First, a catalog was made of the decisions which had to be made in planning for CBT, selecting an appropriate CBT system, and in implementing CBT in an organization. Included in this catalog were the *decisions* themselves, the decision points in the CBT planning, selection and implementation process, and the various options which should be considered at each of these points. Project researchers reviewed the procedures they had successfully used before in assisting various USAF organizations in selecting CBT systems for their training requirements. Each researcher listed those decisions and decision points which they had encountered in the CBT planning process. The researchers also described in detail the information needed to make their recommendations. This step resulted in many overlapping and complementary decisions being identified by the researchers. Also, much of the information which they determined to be useful, was in fact needed for more than one of the decisions. As a consequence, before anything further could be done to structure these decisions into some kind

of logical progression, the researchers had to determine exactly what data was needed for which decision. Then they had to sort through the decisions which had been identified to determine the relationship(s) which existed among them. Of necessity, this second step involved the integration of the two inventories into a single data gathering instrument which could be used in conjunction with the various decisions which had to be made.

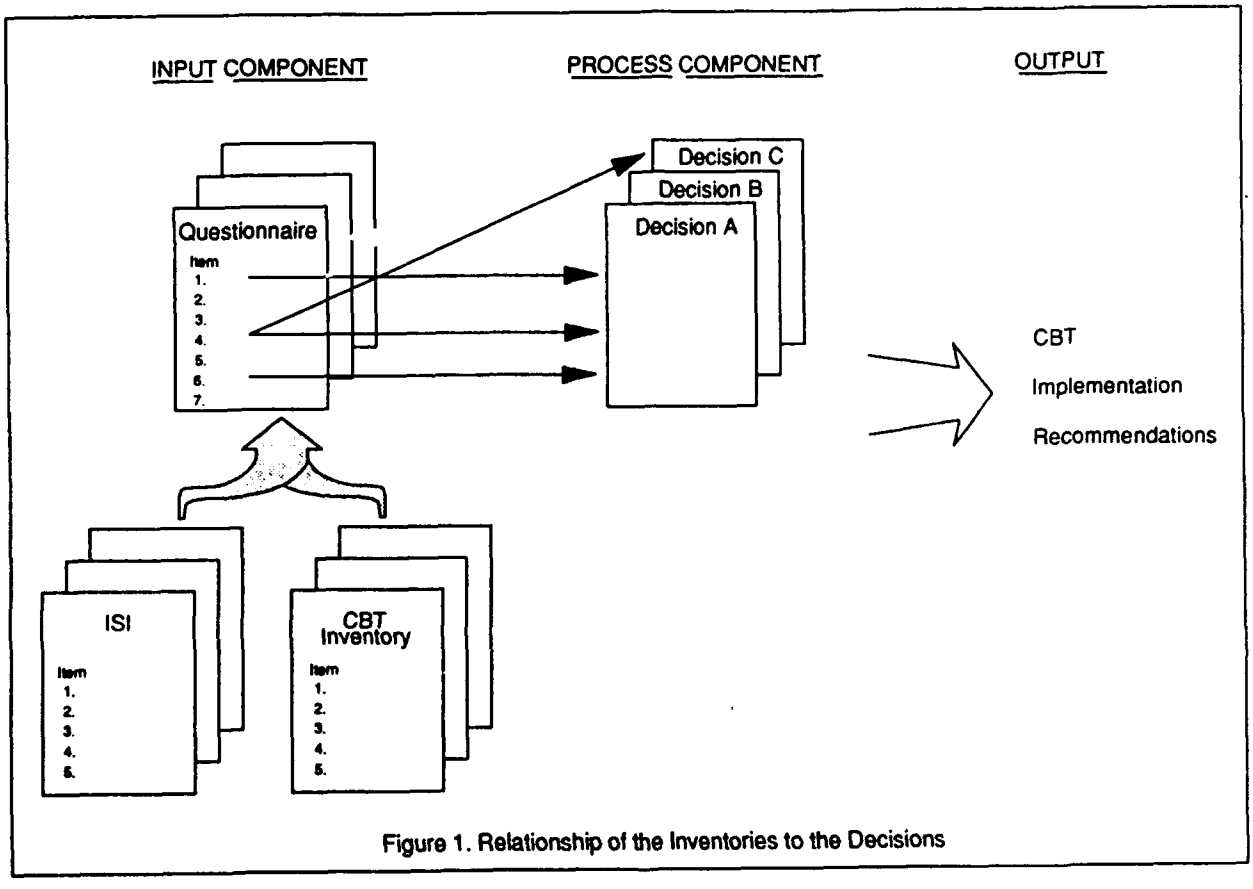

Figure 1. Relationship of the Inventories to the Decisions

The instrument which was being developed began to take the form of an *Input Component* (composed of the Instructional Setting and CBT Inventories, now combined into a single Questionnaire), and a *Process Component* (consisting of 24 separate yet linked decisions through which the users would be lead). Figure 1 summarizes what had been done to that point.

The final step taken prior to testing the instrument on a user organization, was to organize the decisions into a logical order. There were two reasons for this step. First, the order would let the users know where they were at any time throughout the decision process. The often misapplied term, *user friendly*, was the watchword in developing the document. User acceptance of the instrument was critical, and we felt that the more *user friendly* the document was, the better it would be accepted. If the research were to produce a document which would accurately predict an organization's requirements and match these with an appropriate CBT system, such an instrument still might fail unless it were employed by the USAF user in CBT

planning. Anything which would contribute to user acceptance of the instrument was evaluated and, if warranted, included. As a second reason, the structuring of the decisions could also provide another organizing principle for the items in the Questionnaire. (It should be pointed out that the primary basis for the organization of the questionnaire was the *source* of the data. For instance, questions about information which would most likely be found in the same documents, office, or area were grouped together in the questionnaire. This grouping was thought to be the simplest way to structure the Questionnaire for ease of use.)

Another word about *user friendly*. This paper makes a point that the instrument which was developed for Armstrong Laboratory is *user friendly* in a way that none of the other documents which aid CBT users are. What is meant is: when the instrument asks questions, they should be questions the user is able to answer; when the instrument gives directions, the user should be able to follow them; whenever the instrument directs the user to do something, the user should be able to do it; when the instrument tells the user that he will be able to determine something, if he follows the procedures, then it should be obvious to the user what the results are, and when he has achieved them, etc. As an example, most CBT decision aids ask the user such questions as: Are alternate character fonts needed? In our opinion, this question should never be asked of the user. The user really wants and needs help in determining the answer to this question. The questions which should be asked are ones which determine what the user's requirements actually are. Such questions as whether there are various type styles used in existing materials which need to be duplicated in the CBT lessons, etc. The procedures which the user is asked to follow by a decision aid should tell him that alternate character fonts are or are not a factor to be considered in judging which authoring system to use.

What does the structure of the decision hierarchy look like? Figure 2 is the *roadmap* of decisions extracted directly from the instrument. As can be seen from the *roadmap*, the instrument is structured so that a user can quickly determine whether some CBT technology is applicable to the organization's training requirements. At that point in the process the user reaches a *Yes/No* decision. If the organization can make use of CBT, the rest of the instrument is used to determine how to best implement the technology. If the initial decision process does not recommend implementing CBT, the user still has the option of completing the rest of the decisions. If the user decides that CBT should be implemented even though it has not been recommended, he must still complete the rest of the sections of the instrument to determine the specifics of implementation. As he works his way through the various decision points, it will become clearer that he has made the wrong decision. Hopefully, the users will come to the realization that CBT is not always the most appropriate technology to address every training need.

The determination of cost was purposely left to last. Several of the participants in the test group commented that they appreciated this approach. While each organization's decision to implement CBT will ultimately be decided on whether the time, money and personnel required are available, it was still felt that each decision regarding the applicability of CBT should be based primarily on the training requirements. There is frequently enough time and effort devoted to determining whether an organization can afford to implement CBT.

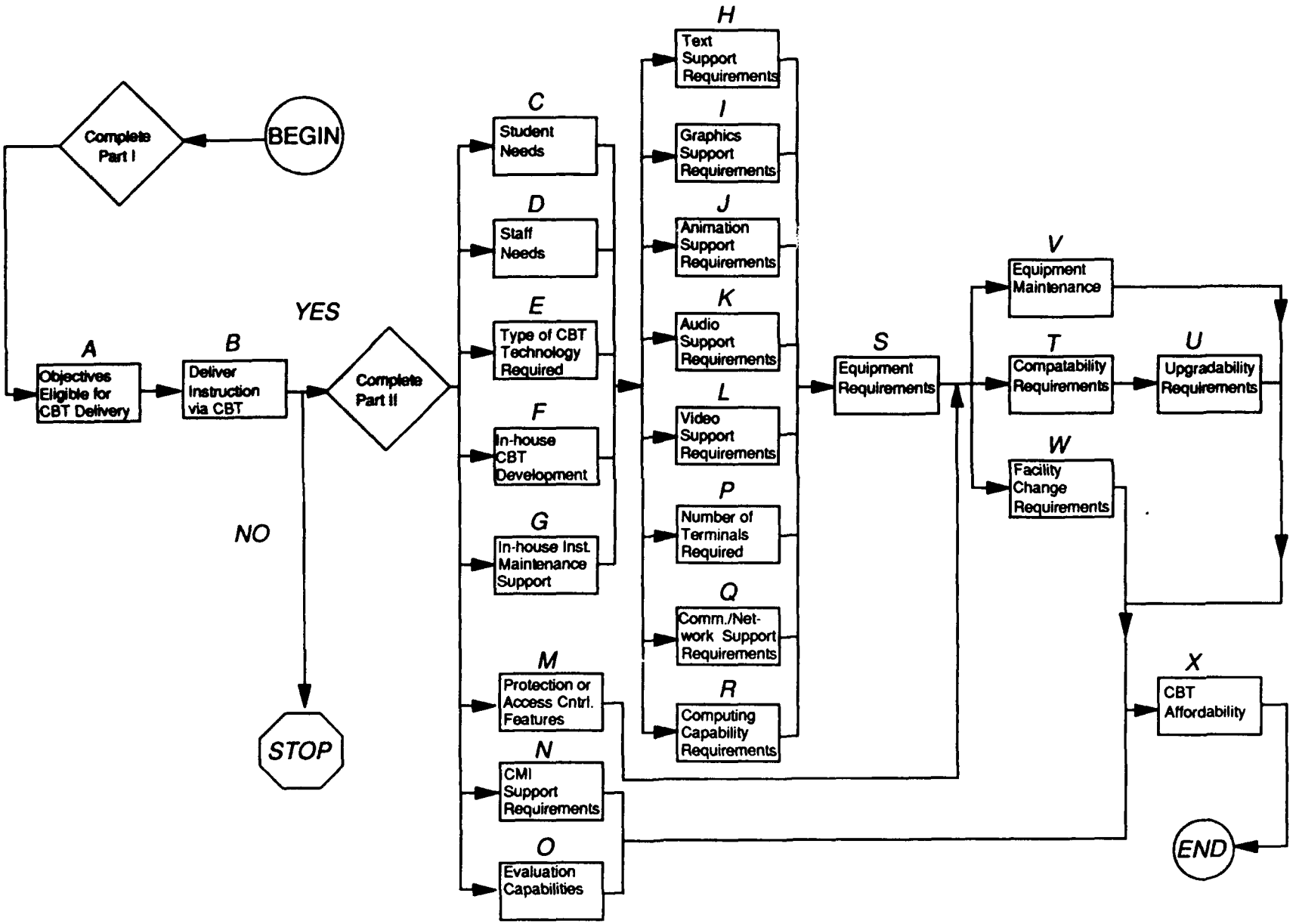

Figure 2. Roadmap

Validate the Instrument with Users

To validate the instrument, Armstrong Laboratory scientists contacted various USAF organizations which were thought to be in the process of planning or selecting CBT. They were able to identify three organizations which were about to begin the planning process at that time. These organizations represented diverse organizational types (two of them being formal schools, the other a training support organization), with different course requirements (one course involved pilot training, the other involved avionics maintenance, and the third logistics), and varying levels of CBT experience (two organizations were inexperienced, the other had a few personnel with CBT experience on staff). Each organization was contacted and asked to participate in the study. Each organization was enthusiastic about participating. They felt that any help in this area would be useful.

The validation process consisted of two steps. First, the organizations were visited by the Armstrong Laboratory program manager who provided them with copies of the instrument and briefly consulted with them on how to make use of it. The program manager remained on-site at the organization throughout a portion of the time that they were using the instrument. This presence was to ensure that organizations would devote sufficient time to working with the instrument, and to answer any questions which might arise regarding interpretation of what the instrument meant. The program manager was fully aware of what the instrument consisted of, but he did not participate in the development of the questionnaire or the various decisions which comprised the instrument. The feeling was that his presence at the organization would ensure cooperation, yet still allow the instrument to stand on its own.

The second step in the validation process was debriefing the organization after they used the instrument to determine the applicability of CBT technology. A staff member was sent to each organization after they had used the instrument. The researcher interviewed each participant in the program. The interviews concentrated on three things:

1. Did the instrument help the organization reach a decision regarding CBT?

2. Were the users satisfied or dissatisfied with how the instrument helped them achieve the organization's goals?

3. Was the instrument *user friendly*?

Once the interviews were completed, the information gathered from each organization was compared to determine if there were trends in their comments. There was unanimity among those participating that the instrument helped them through the CBT decision process. If they were inexperienced, they said that the document provided organization to the process and guided them through several decisions which they would never have thought of otherwise. If they had some experience, they said that the instrument was *something that they needed two years ago.* Although there were several comments regarding desired changes to specific items on the questionnaire or formulas in the various decision sections, each participant felt that the instrument was just what they needed. Their specific comments regarding suggested changes to the document to make it more *user friendly* were also collected and analyzed. The changes

recommended by the participants were evaluated with other data to determine which ones would be implemented prior to further testing of the instrument with other organizations.

Validate the Instrument with CBT Experts

Armstrong Laboratory was encouraged by the results of the pilot testing of the instrument. However, a second test of the instrument involving CBT experts yielded even more surprising results. The Laboratory has always had concerns regarding the validity of the instrument. Their concerns were that in spite of the fact that the instrument was successful in some individual cases, how could one predict that it would be just as successful in other applications? The argument was posited that the instrument was supposed to take the place of a feasibility study which would normally be conducted by an expert CBT consultant. Therefore, let the results obtained from the instrument be compared to the results of an expert when given the same information about the organization.

Armstrong Laboratory scientists agreed that the best way to assess the validity of the instrument was to compare its results to those of an expert. The only question which remained was: *Who were the experts?* The Laboratory contacted many USAF organizations involved in CBT to get their opinion on who they felt were recognized experts in CBT technology. In particular, they sought experts in CBT planning, selection and implementation. Several experts were identified, and from that group four were selected to participate in the validation. The Laboratory convened the panel of expert CBT consultants in October 1990. The group of experts were highly qualified having a combined total of over 27 years of CBT experience. As a group they had been involved with all stages of CBT, in particular the planning, selection and acquisition of several large scale USAF CBT systems involving hundreds of users. They had also been called upon from time-to-time to provide advice in planning for smaller, more specialized CBT systems. They were familiar with the state-of-the-art in CBT technology. Their experience extended to numerous different hardware and software configurations. The Laboratory felt confident that these CBT experts knew what they were talking about.

These four individuals met for four days to validate the instrument. The experts were only partially informed of the conditions under which they were being assembled. They were told that their services would be needed to validate a process of selecting CBT. When they arrived, they were briefed by the Laboratory Program Manager regarding the general goals of the program; however, they were not given any information about the instrument which had been developed nor the results of the first pilot test. In fact, they were unaware that the instrument had been developed yet.

Having thus set the stage, the group was given its first task. The task consisted of asking them to provide expert consultant services to an organization which was considering CBT. One of the two pilot test sites was selected as the basis for comparison. The data from that site was made available to the expert panel, but only if/when they asked for it. In withholding the information that had been gathered from the organization, the objective was to determine if the experts would also ask for the same or similar information. As the information was requested by various panel members, it was provided to the group. The experts were observed by personnel from Armstrong Laboratory and from the research staff to document whatever decisions,

recommendations, and questions they might have. The experts were informed that they would have to debrief Laboratory scientists at the end of the second day. In their debriefing they were to provide whatever advice they felt the organization would need in planning, selecting, and implementing CBT. They were also to provide a description of what they did and why they did it.

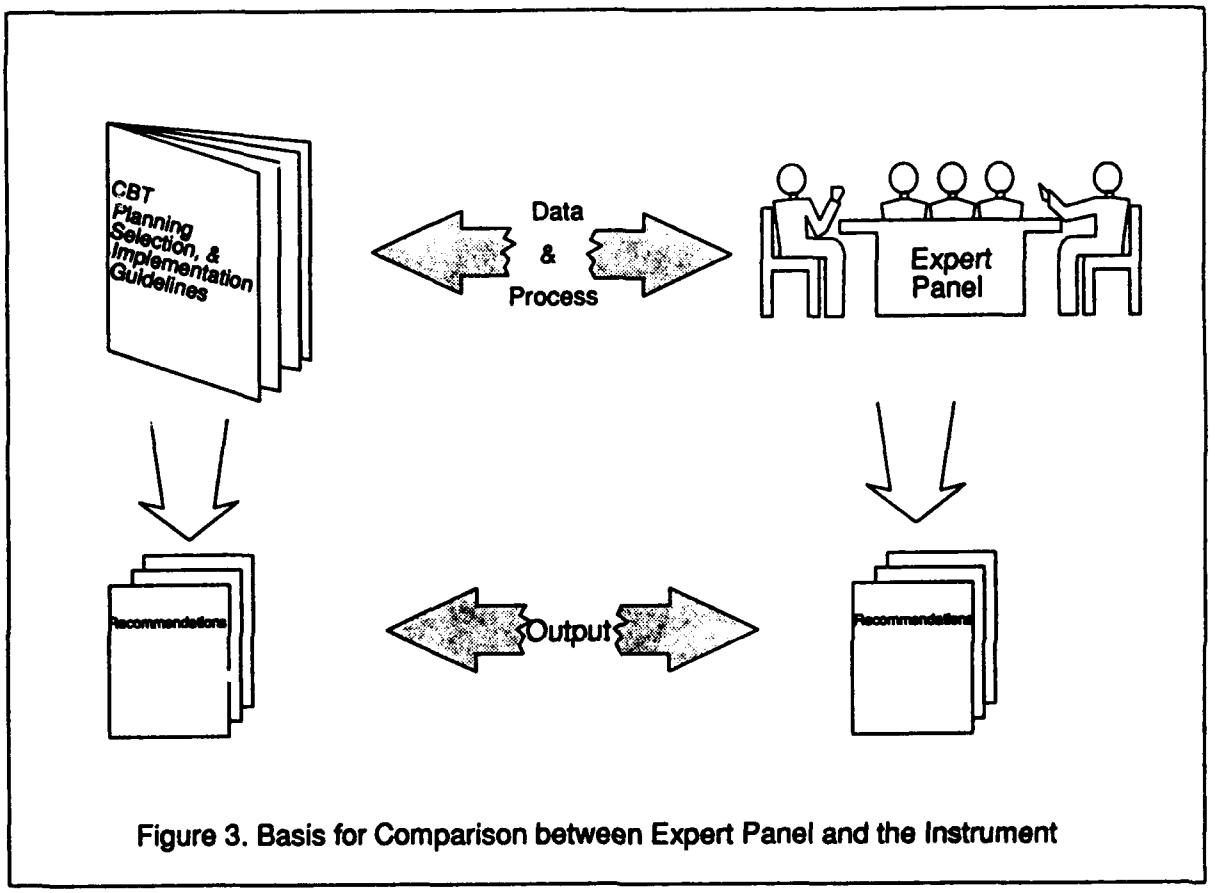

Figure 3. Basis for Comparison between Expert Panel and the Instrument

At the end of their first task, the expert panel provided their CBT recommendations for the selected organization. The recommendations of the expert panel and the conclusions arrived at by inexperienced personnel using the instrument were very similar. Both recommended CBT for a subset of the objectives; both recommended using a network configuration to gather computer-managed instruction (CMI) information; both recommended using CBT as a type of *part-task training*; and, both estimated the amount of time and personnel required to develop CBT in-house, etc.

During and after their briefing the expert panel was still not told of the results arrived at by inexperienced personnel using the instrument. All of their input was received, essentially without comment regarding its relevance to the validation of the instrument. The intention with regards to the expert panel's recommendations was to use these comments as a basis for comparison with the conclusions arrived at by the user organization using the instrument. But the results achieved were not to be the only basis for comparison. It was also considered important to look at the other two components involved in making a CBT decision, namely the

information required, *the Input* and the method used to make each decision, *the Process*. As can be seen from Figure 3 the intention was not merely to match the recommendations of the panel with the conclusions of the instrument, *the Output*. That would still leave a *black box*, i.e., how do the processes compare, and how do the data needed by each process compare. As a consequence, the research team observed the procedures used by the experts in arriving at their recommendation, asked them to explain why they did various things, and noted the information which they thought necessary to make their decisions.

Once they had completed their debriefing, the expert panel was informed of their second task, i.e., to critique the instrument. They were informed of the purpose of the instrument, how it was created, and briefly, how it was organized. The panel members were directed to take the document away with them to review on their own. Working alone they were to review it and critique its contents, format and approach. They were asked to be as critical as they could be, but to do so in a positive way, i.e., whenever there was something which was not to their liking, they were asked to suggest an improvement. Each expert was asked to prepare another briefing of his own critique of the instrument. Without being directed to do so, each person focused on a slightly different aspect of the instrument during his critique. The experts provided the specific, detailed criticism expected of them. On the whole, their acceptance of the instrument was remarkably universal. As a matter of fact, each participant requested that they be provided a copy of the finished document to help them in future CBT planning. One of the panel members suggested that a follow-up test of the instrument be performed with an organization which he knew was contemplating CBT, but was inexperienced in CBT planning, selection, and implementation.

III. CONCLUSIONS

What the Instrument does and does not do!

What do the advice or recommendations provided by the instrument look like? The last thing which is needed or wanted by user organizations is a single solution to multiple problems. In other words, a standardized CBT system for the entire USAF (or even some major commands with diverse needs) would do little to provide an appropriate training solution to the myriad of environments which are to be found in USAF formal schools. Also, the managers of training programs do not need a tool which provides them with only a single solution to match their training needs. Managers must be able to make decisions given various alternative approaches to their training requirements. They need an instrument which gives them more than one way to look at the training requirements and potential solutions. As with most good managers, training managers need to be able to play *What if?* with the solutions to their problems. The instrument which has been developed allows them to do just that.

Since the advice of an expert consultant retained for a feasibility study of this type would normally result in the production of several documents needed by the organization to acquire the recommended CBT system, the instrument attempts to emulate that same approach. The Output Component of the instrument either provides or causes the organization to gather the necessary information required to acquire the CBT system. An expert would probably leave an

organization with something approximating the information listed below; therefore, the instrument also provides the same data:

- A description of which objectives can and cannot be converted to CBT. The instrument makes this determination right up front. It is the basis for all further CBT planning. The instrument will indicate to an organization how much of its curriculum can be converted to CBT. It leaves the decision as to how much will be converted up to the organization's managers. They will have to determine what they can afford to do given the resources that they have available to them.

- Recommendations as to which CBT technology (e.g., computer-assisted instruction (CAI), interactive video (IVD), digitized video interactive (DVI), simulation, etc.) would suit the organization's needs. Such a recommendation would normally consist of two parts: a description of the applicable CBT technologies and which objectives the technology is suitable for; and advice concerning the cost effectiveness of the implementation of the CBT technologies. (The instrument provides specific recommendations as to what type of CBT technology can be used. The instrument also leads the user organization through its curriculum to determine how sophisticated the CBT system and lessons will need to be.)

- Some rough order of magnitude estimate of the cost of implementing the CBT technology, both in terms of dollars required, personnel needed and facilities change requirements. (As was mentioned before, costs are not computed until the very end. When costs are computed, the organization will be able to determine where they stand. Namely, if they will need to submit a Program Objective Memorandum (POM) for the required resources; if the amount needed is beyond all hope of ever achieving; or, if CBT technology might be feasible using in-house resources, etc.)

- The data needed for a specification which the organization could use to acquire the system. Normally, no expert would recommend a single specific system as the only way for an organization to go; therefore, the specification would be based on the organization's requirements and provide the organization the means of judging among several competing systems. (The instrument does not automatically produce a specification, but it does gather and organize almost all of the information required to construct such a specification.)

<u>What the instrument does not do.</u>

This document was rapidly developed and serves as a prototype for CBT planning, selection and implementation decision making. The instrument has only been tested on a limited number of organizations; therefore it must still be considered preliminary until more definitive results are obtained. One problem associated with testing this instrument is that the number of organizations considering implementing CBT at any one time is rather small. Once an organization contemplating CBT is identified, getting the organization to participate in the study

will probably not be a problem (each organization contacted during this study readily accepted the opportunity). Given the small number of organizations contemplating CBT during a specific period, obtaining sufficient data from continued testing of the instrument might pose a problem. Depending on what criteria were established for acceptance of the results of such a test, Armstrong Laboratory may be able to continue testing with internal USAF resources.

Recommendations

The modular structure of the instrument, and the direct linkage which has been established between the various questions in the questionnaire and the CBT decision points makes the instrument a prime candidate for automation. Various levels of automation can and should be applied to the instrument. By automating the instrument, its usefulness to the user increases significantly. As a paper-based tool, the instrument is limited to the single set of answers that the organization provides. By automating the system, the instrument allows the organization to try out several different configurations before settling with the one that suits their needs and they can afford. Several levels of automation are available to the USAF:

1. **Simple automation.** This could be accomplished by programming the various decisions to take advantage of a data base of information constructed by the questionnaire and objectives, and some kind of interactive spreadsheet to perform the cost and sizing functions.

2. **Sophisticated programming and branching.** This level could be achieved by more extensive programming to link various questions and change parameters within the program shell. The user would be branched to certain sections or around others depending on answers to previous questions.

3. **Artificial intelligence.** This would allow the user to interact with the program and be advised about new decisions he needs to make based on decisions which he has made previously.

The entire document which comprises the CBT Planning, Selection, and Implementation Guidelines has been attached to this report as Appendix B. At first glance, its size seems rather imposing, but the amount of effort which can be saved by its use will well offset the document's large volume. When we think of the weeks, and even months that feasibility studies take, and compare that time to the one or two weeks which each of the participating agencies took using this document, the size of the document becomes irrelevant.

Other CBT Decision Aids

Prior to developing the instrument, the research team investigated commercially available CBT decision aids which might perform comparable functions. Several systems were examined, and the literature reviewed. Although there are several systems available which perform media selection, and others which perform cost analysis of alternative media, none of the systems examined consider the complete range of variables utilized in the instrument to make a

recommendation. It was not the goal of the researchers to conduct a comprehensive review of commercial automated CBT decision aids, but they did attempt to contact a number of vendors to determine what kind of systems were available. After reviewing several systems, the researchers determined that an inexperienced USAF organization considering CBT would need assistance in several more areas than those provided by the commercial systems. The development of the instrument was aimed at plugging some of the gaps identified in these systems. A complete listing of the commercial CBT decision aids examined during this project can be found in Appendix A.

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APPENDIX A: COMMERCIAL CBT DECISION AIDS

1. *Training System Selection Tool (TSST)*, ($6,000) Computer Knowledge International, Akron, OH.

This package consists of a Guidelines Manual and diskettes. The program covers the following media: classroom, tutored video instruction, interactive television, computer- based training, PC with videodisc, and self study. Tutorial program to train the user in the characteristics, advantages and limitations of each delivery system. The user provides input of objectives to the TSST, and it calculates several factors associated with the media, including costs and manhour requirements for development. A comparison of the various media costs is provided.

2. *Training Cost Model*, ($49.95) Future Systems, Inc., Falls Church, VA

This package consists of a user's manual and diskettes. The model compares classroom training costs with interactive learning costs. The user is able to input a limited number of variables to the system such as number of trainees, length of training, cost of student/staff, travel costs, etc. The system calculates comparative costs for each alternative; a graphic option allows these to be displayed as a bar chart. The system allows for up to nine iterations of a course to assess break even points, or increases in cost.

3. *Cost Justification Model*, ($149.00) Sealund & Associates, Clearwater, FL

This package consists of diskettes and a cost checklist which can be printed out. The model compares classroom training with CBT. The user must input several variables, including course length, development time, number of students, labor costs, travel costs, authoring system costs, authoring system lifetime, etc. The system then generates a comparative graph of CBT versus classroom training. Several courses can be stored for future use.

4. *Cost/Benefits Analysis*, ($39.95) Park Row, Inc., San Diego, CA

This package consists of diskettes. The software was designed to complement Kearsley's Cost, Benefits, and Productivity in Training Systems. The system employs several cost- benefit models, including comparison of media, life-cycle costs, break even point, the relationship of training activities to training outcomes, resource estimation, etc. There is an Advisor to provide the user with information as to which model to utilize. The user selects from the models, enters the variables, and the system plots the results graphically. The program allows data to be saved for later use.

5. *The Expert Media System*, ($149.95) IntelliSys, Inc., Syracuse, NY

This package consists of diskettes. The system consists of three modules: the Learning Analysis Module, the Cost Module, and Editors. In the Learning Analysis Module the user first classifies the objectives of the course with the assistance of the program, then specifies the level of performance for the objective, and finally the system assigns a medium to the objective with the option of user override. The assignment of media provides several options to the user. Each of the options is rank ordered by desirability. The ultimate media decision is then made by the user. Once media have been selected costs are calculated in the Cost Module. The Cost Module provides break even point, development costs, recurring costs, and media comparative costs. It also provides student through-put cost modeling. The Editor Module allows the user to change the various default cost values, store multiple versions of the same course to disk, or change some or all of the cost data provided in previous work sessions.

6. *TRACE (Training Requirements/Attributes Concurrence Evaluation System*, ($75,000) TRACE Technology, Inc., Fayetteville, NY

TRACE is a CASE tool for developing, implementing, and managing training systems. It runs on a host system. This more extensive program uses the SQL relational database to provide users with the ability to conduct task analysis, develop proficiency standards, develop objectives, and develop curriculum. Although there are no indications that the system provides support to user media selection, it does have subsystems which include student assessment, implementation and scheduling, evaluation, target system analysis, lesson/storyboard/media specifications and tracking, etc.

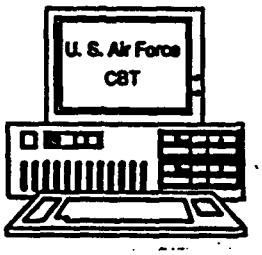
7. *Forecasting Financial Benefits of Human Resource Development*, ($39.95) Jossey-Bass, Inc., San Francisco

This package consists of diskettes and the book, Forecasting Financial Benefits of Human Resource Development by R. Swanson and D. Graduous. The software does not provide information on the models used nor on the various training media. All such information must be gleaned from the book. The user provides various data for the model worksheets to calculate costs and benefits of various media.

APPENDIX B

U. S. Air Force
Armstrong Laboratory
Human Resources Directorate

CBT Planning, Selection & Implementation Guidelines



June 4, 1991

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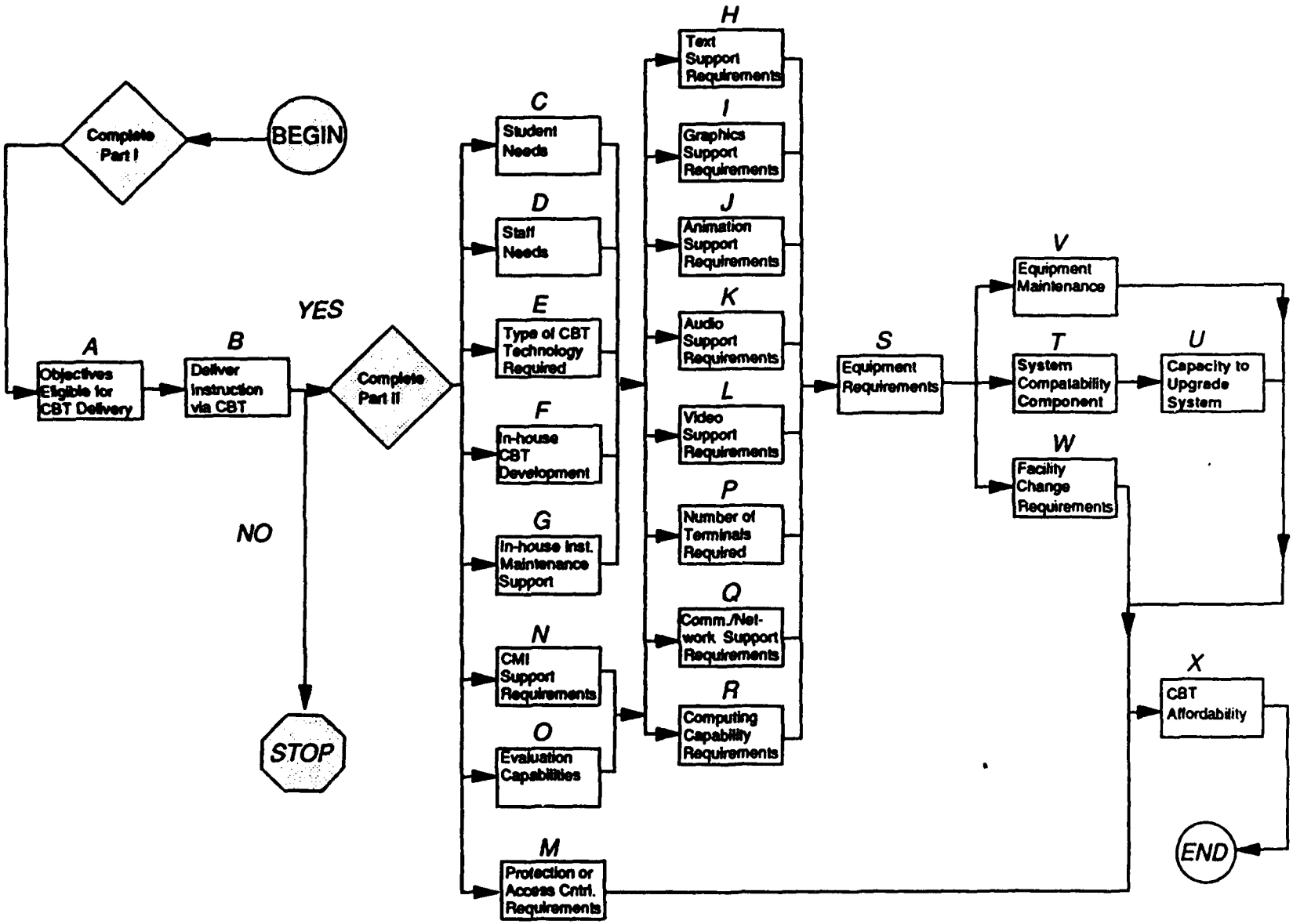
Table of Contents

Volume I -- Decision Packets

Volume II - Questionnaire



GUIDELINES ROADMAP

INTRODUCTION

Computer-based training (CBT) is a term commonly used to refer to any training that relies, in part or whole, on computer technology to manage, develop, deliver, and evaluate student learning activities. Various CBT technologies such as Interactive Videodisc (IVD), Digital Video Interactive (DVI), etc., are being used more and more widely in the Air Force and other parts of the Department of Defense to provide personnel with essential job knowledge and skills. These CBT technologies can increase training effectiveness and efficiency when appropriately employed. However, when inappropriately employed, CBT can result in ineffective instruction and substandard learning; increased learning time; excessive costs for courseware development, logistics and maintenance; increased personnel requirements; and unacceptable changes in the training organization's operating structure, functions, and resources. Presently, these problems only manifest themselves when CBT courseware development or CBT system implementation and testing have begun. These guidelines were developed to assist Air Force managers in planning, selecting and implementing CBT. The goal is to eliminate or avoid common problems associated with the introduction of CBT into an Air Force organization. All activities of these guidelines are based solely on the training requirements (learning objectives), no more and no less.

PURPOSE

As we have mentioned, this document was developed to serve as a desktop guide for USAF training system managers, planners, or other individuals with the responsibility for providing input and making decisions about CBT implementation. The purpose of this document is to help organizations to:

1) Determine if CBT can be used as a training medium. If CBT is found to be an acceptable medium for an organization's training requirements, then:

2) Match appropriate CBT technology(ies) with the learning objectives;

3) Assess the impact which CBT technology may have on the organization, including facilities, personnel, organizational structure, and operations; and,

4) Estimate the affordability of CBT technology in terms of time, people and dollars.

It is not the purpose of this document to educate its users as to what the various CBT technologies are, how these are best used, how to develop interactive courseware (ICW), etc. There are currently several very good reference documents available to Air Force users which do these very things. Rather, these guidelines are fully focused on leading an Air Force user through the various steps and decisions which must be made in order to determine if CBT is appropriate, to select the right system for their needs, to plan for CBT implementation, and to determine a rough order of magnitude cost.

These guidelines can stand on their own. No other references are needed. If you, the user, follow the instructions contained herein you will be able to properly plan for the implementation of CBT. However, there is nothing better than an educated consumer. The more knowledge which you, as an Air Force manager planning CBT, bring with you, the better able you will be to acquire the best system for your organization. You should consult the references listed in the bibliography, other government and commercial documents on computers and computer-based training, and finally, individuals who are experienced in various aspects of CBT from planning through implementation.

This document assumes that you, the user, are early in the process of either converting a portion of your instruction to CBT or designing new instruction to be delivered via CBT. Traditionally, organizations considering implementing CBT conduct a feasibility study to determine how to best do it. Frequently, these studies are conducted by CBT experts who are consultants or come from some other organization. Their advice serves as a basis for the organization to make decisions about implementing CBT. This process can take several weeks, sometimes several months to complete. These guidelines are aimed at helping the user organization, i.e., you, make the same decisions in a much shorter time. We have tested these guidelines with several user organizations, and they have been able to complete them within a week or two. Although these guidelines can never completely take the place of a CBT expert consultant, they, at least, lead you through the same steps and provide the same kinds of recommendations which a feasibility study conducted by a CBT expert consultant would. The advantage of these guidelines is that they are immediately available to you and you can make changes at a moment's notice.

ORGANIZATION

This document has been organized so that a single individual or several personnel from the same organization can complete parts of it. You may want to divide it up or assign various branches various sections based on their responsibilities. Remember that many decisions are related to others and cannot be completed until the previous ones have been done. It is usually advisable to include as many people as possible when planning CBT. This ensures that all segments of the organization have "bought into" CBT, and it allows those who have something "extra" to give an opportunity to contribute. The amount of time it takes you and your organization to complete the decision process may vary because of several factors including the size of the course(s) being considered for CBT, the number of personnel participating in the data collection and decision making process, and any special circumstances which are peculiar to the organization. These guidelines were developed so that the worksheets could be removed and copied locally to meet your specific needs. The guidelines consist of three sections:

1) A set of 24 decision packets (Volume 1);

2) A Questionnaire (Volume 2); and

3) A set of worksheets (these are duplicates to be used for reproduction purposes).

These guidelines are divided into 24 separate decisions. The worksheet(s) for each decision is designed to assist in collecting data and defining CBT requirements. A typical decision packet consists of a short statement of purpose, one or more decision worksheets, instructions on how to complete them, and a description of how to interpret and apply the results. In one instance, no worksheet is provided. All decisions provide guidance about some aspect of CBT implementation; most also serve as a place for you to record information about the characteristics you will require in a CBT system. This is important because you may be required to write a specification for the acquisition of the CBT system.

Generally speaking, these guidelines work by having users answer questions, and then make decisions based on the answers to those questions. Some decisions also rely on previous decisions. The inter-relationships between the questions and the decisions are illustrated in the roadmap which appears at the beginning of this document. On that roadmap you will see that the guidelines are divided into two parts. The first part (Decisions A and B, and Questionnaire, Part I) should always be completed by the organization. At the completion of these sections your organization should be ready to decide if CBT is appropriate for its requirements. If CBT is <u>not</u> indicated as appropriate, no further action is necessary. The manager has assessed the organizational climate and training requirements and found that some other instructional method(s) and/or media must be applied. You can stop at that point. There is no need to complete the rest of this document. However, if CBT <u>is</u> indicated, the organization should then complete the rest of the guidelines to determine what the specific CBT system requirements are, and how to plan for them.

HOW TO USE THESE GUIDELINES

General Advice

To use these guidelines, it is important that you have in mind a particular "piece of instruction" that you are considering implementing via CBT. This piece of instruction may range from a section of a course, to an entire course, to a group of related courses. It is also important that the instruction be already defined in terms of particular instructional objectives that are based on the results of a formal task analysis. This information is absolutely essential in defining the requirements for your CBT system. If the objectives have not been clearly written so that they define a specific instructional outcome to each training event, you will need to do that before beginning to use these guidelines.

You will begin the CBT decision process by answering the questions contained in Part I of the Questionnaire. This information will provide most of the data required for completing Decisions A and B. Remember that these guidelines are aimed at significantly reducing the time it would otherwise take to complete a formal feasibility study. Formal studies, such as feasibility studies, can last several weeks to several months so don't be surprised if it takes you some time to compete Decisions A and B.

It is not expected that a single person will have all the information needed to answer all the questions on the Questionnaire or be able to provide all the needed information for completing the decision worksheets. The required information may need to be gathered from various personnel in your organization; certain sections or questions may even be assigned to particular individuals for completion. Some of the information needed to complete these guidelines may not be immediately available, and parts of it may have to be completed later when the information becomes available, such as costs or the availability of funds. Additionally, some portions of this document may not apply to your organization or mission. In this case, you may wish to omit those portions. It is advisable that at least one individual work through all the applicable decisions. You should feel free to use this document in any way that suits your organization's needs. It can be taken apart, copied, portions distributed to various components or individuals for completion, etc. The worksheets have been designed to be removed from the document and reproduced in sufficient quantities for use. If you feel that changes are in order as to how the document is structured, the format of any of the worksheets, or how the instructions lead you through the decisions, please make note of your ideas and provide your suggestions to:

Armstrong Laboratory
Human Resources Directorate
Technical Training Research Division
Instructional Design Branch
Brooks AFB, TX 78235
(DSN 240-2982)

Although not all decisions are dependent on previous decisions, many are. To keep things simple, it is recommended that you proceed through the decisions in the order presented in this document and depicted on the roadmap.

General Instructions

1. Complete Part I of the Questionnaire. Because no single person may have available all the information to answer all the questions in this section, it may be necessary to assign some questions to someone who can (e.g., classroom instructors, instructional developers, subject matter experts, etc.).

2. Once you have answered all of the questions in Part I of the Questionnaire, you can work through Decisions A and B. At this point, you may decide that CBT is not appropriate for the instruction under consideration. If so, you should stop. You do not need to complete the rest of the guidelines. Otherwise, you should continue on to Part II of the Questionnaire.

3. Complete Part II of the Questionnaire. As with Part I, if you are personally not able to complete some of these questions, find an individual within your organization who can answer the questions.

4. Complete Decisions C through X.

5. Depending on how you wish to implement CBT within your organization, you may have to develop a specification for the acquisition of equipment or services, or you may be able to do all the work internally. Read the section of the Conclusion that applies to your situation and develop the documents that pertain.

DECISION A
Objectives Eligible for CBT Delivery

Not all training is appropriate for CBT. For example, training objectives which require the performance of procedures using actual equipment should not be delivered on CBT. The purpose of Decision A is to help you to identify which of your objectives are most suited for delivery via CBT. In the instructions and worksheet following, you will be asked first to list and characterize your objectives, and then to consider eliminating those which are less suitable for CBT. After completion of Decision A, you should have a list of those objectives which are most suitable for delivery via CBT.

Again, we must remind you that it is absolutely essential that the objectives be defined very specifically before beginning this exercise. That means, if it is required that the student use the actual equipment - not a simulation of the equipment, then that should be stated in the objective. It might be necessary for you to redefine some objectives or to break some current objectives up into several new objectives in order to meet these conditions. If this is the case, do it now.

The worksheet for this decision has been designed to assist you in identifying those objectives which are best suited for delivery via CBT. If an experienced instructional designer/developer is available, have that person work through this interpretation process with you. If at any time you disagree with the recommendations that result from these guidelines, please make note of your reasons in the "Notes" portion of the worksheet. The guidelines provide general guidance which must be applicable across commands to all kinds of organizations. Only you have the first-hand knowledge of your organization's specific needs, therefore, if you must depart from the guidance provided, do not to hesitate to do so. Please make note of any such exceptions and bring them to the attention of AL\HRTC so that this instrument can be modified or updated, as required, to meet the needs of all Air Force users.

The worksheet for this decision can be found on page 9, and is divided into four sections. Refer to the instructions below to complete each section.

Worksheet A
Section 1

In this section you will list your objectives and classify them according to their required behaviors, conditions, and standards. To complete this section, use Section 1 of Worksheet A.

Section 1 Instructions

1. Using an abbreviated title or other notation to identify each objective or group of objectives being considered for CBT, list both terminal learning objectives and enabling

(or supporting) objectives in the column titled "Objectives." If there are not enough lines to record all objectives, copy the form so that you will have sufficient worksheets to completely list all objectives.

2. Next, classify each objective behavior as a knowledge or a skill by placing a check in the column headed "Knowledge" or the column titled "Skill." Some verbs that might be used to describe knowledge-based behaviors are *analyze, classify, determine, identify, locate, predict, select, state, or verify.* Skill-based behaviors will typically involve psychomotor skills and can be described with verbs such as *adjust, align, calibrate, demonstrate, install, operate, perform, or repair.*

   Note: When considering the skill-based or performance-type objectives, keep in mind that skill-based objectives often have knowledge-based components. For example, an objective which requires a student to assemble or disassemble a piece of equipment is skill-based, in that it should be tested by having the student use the actual equipment. However, achieving this objective also requires knowledge about parts and procedures. If this is the case for any of your skill-based objectives, and if this knowledge requirement is not explicitly provided for elsewhere (e.g., by the other objectives, or by the student's prior knowledge/experience), place a check in both the "Knowledge" and "Skill" columns corresponding to this objective.

3. Refer to question 12 on the Questionnaire. If the answer to the question is **Yes**, then identify those objectives listed on the worksheet requiring unusual or highly specialized conditions which cannot be simulated by CBT by placing a mark in the column headed "Conditions."

4. Refer to question 13 on the Questionnaire. If any of the options which cannot be simulated by CBT are selected, identify those objectives listed on the worksheet requiring this level of behavioral measurement by placing a mark in the column titled "Standards."

5. Refer to question 7 on the Questionnaire. If the answer to question 7 is **Yes**, identify those objectives listed on the worksheet which are optional by placing a mark in the column titled "Optional."

6. Refer to questions 2 and 3 on the Questionnaire. These questions must be considered together in assessing the potential impact of courseware revision on the implementation of CBT. If the answer to question 2 indicates that course revisions are being made frequently (three or more times per year), and question 3 indicates that a significant portion (greater than 10% of the course hours) is being affected each time, then identify those objectives which undergo frequent revision by placing a check in the column headed "Changes."

Note: Even if courseware revisions are made on a less frequent basis (less than three times a year), the course may still be considered "unstable" if a significant number of hours undergo revision (those in question 3 are greater than 40% of the course).

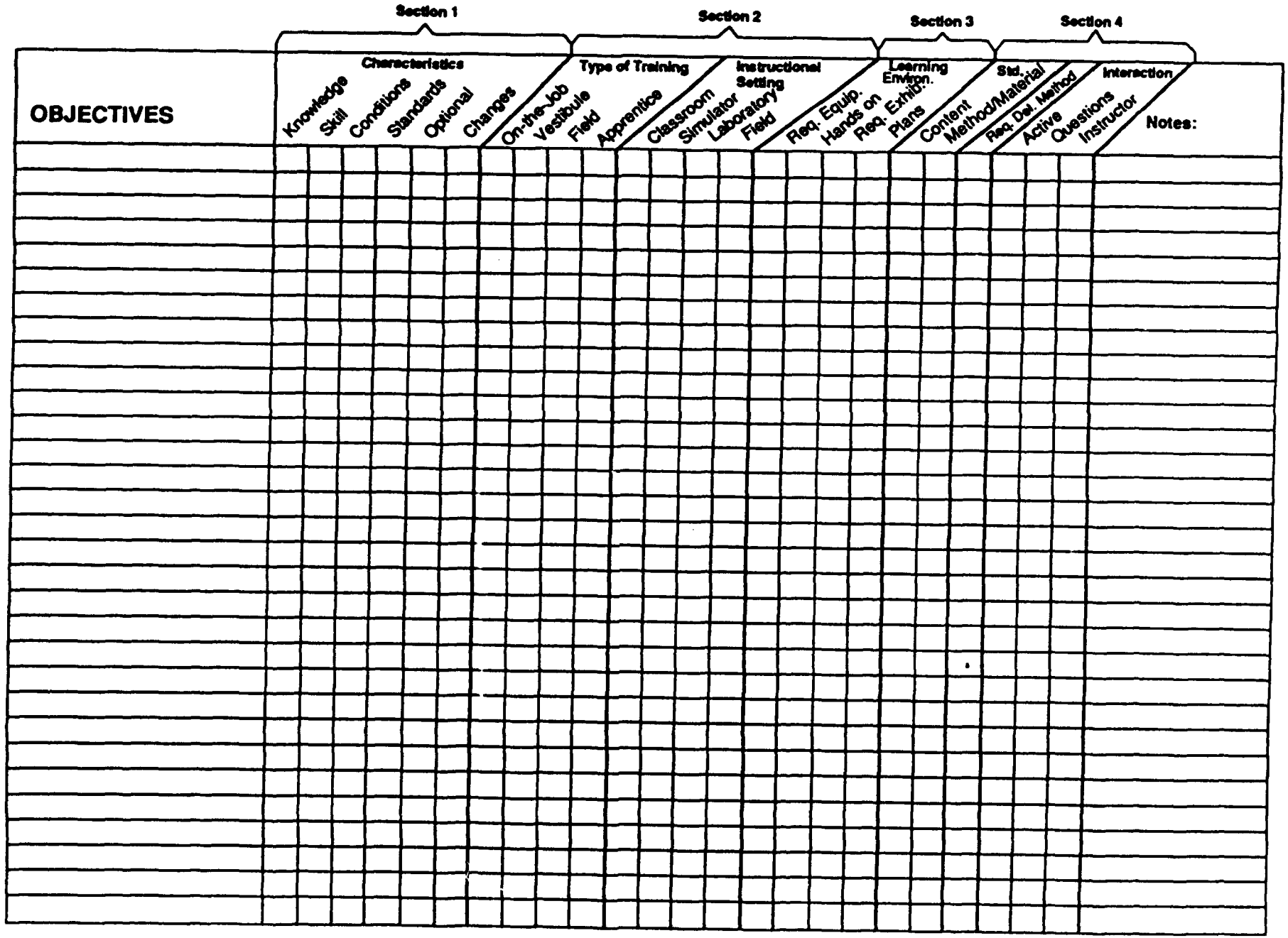
7. Refer to question 8 on the Questionnaire. If the answer to question 8 is **Yes**, and these changes are anticipated **within 18 months**, then identify those objectives under consideration for revision by placing a mark in the column headed "Changes."

8. Review the interpretation for Worksheet A, section 1. Based on the guidance provided there and the information from the blocks you have just checked, line out those objectives for which CBT is not appropriate because of the training characteristics assessed in section 1. Again, if you disagree with a recommendation, make a note of it in the "Notes" column of the Worksheet.

Decision A

Objectives Eligible for CBT Delivery

Worksheet A



Section 1 Interpretation

This section will help you to begin to eliminate objectives based on the notations you've made so far. The purpose of this elimination process is to allow you to derive a core of objectives which are most appropriate for CBT. Just because an objective is eliminated does not mean that it cannot be delivered via CBT successfully (or that you cannot change your mind later); it just means that it is not a prime candidate for CBT delivery.

Knowledge versus Skill

In general, CBT is an excellent training medium for knowledge-based objectives. Its ability to provide interactivity, graphics/video presentation, and individualization can make a CBT lesson much more effective than a book or a lecture. Although CBT cannot replicate the exact performance skills required on the job, it can be suitable for skill-based objectives. For example, if the objective aims at teaching how to operate a piece of equipment, CBT can be an excellent training medium, particularly if the equipment is scarce, dangerous, or can be damaged by the frequent and repetitive use by students. Don't confuse the need to be sure that a trainee can actually perform some task using the actual equipment, with the teaching steps leading up to getting the student ready to perform that task. CBT can easily simulate most equipment. Students can learn the various parts and components of the equipment, how to operate it, including what happens when things go wrong, and be tested on all of this knowledge and skill using CBT. In order to verify that the student can perform on-the-job however, a final objective might require brief practice using the actual equipment, then a test on the equipment to verify the transfer of knowledge from CBT to using the actual equipment. As a further example, an aircraft does not have to be flying for a student pilot to learn where each dial and gauge is located in the cockpit, or to learn what effect moving a switch has on the instruments. This knowledge can easily be simulated by CBT. But we would never send a student out to fly alone, who had not also practiced using these instruments in an operating aircraft and demonstrated his proficiency.

You will have to evaluate all of the skill objectives carefully before eliminating any for consideration. Some skill objectives may not lend themselves to being simulated very well on CBT. For example, you probably wouldn't want to teach skills like giving a lecture or classroom demonstration using CBT. Some other medium, like videotape, might be much more appropriate. However, the principles of giving a lecture, or the various techniques which can be used in performing a classroom demonstration, can be taught quite effectively using CBT.

Review the objectives which you've marked as skill-based. If any of these cannot be taught and/or tested via CBT because of some peculiar characteristic, eliminate them by drawing a line through that objective. (Use a pencil in case you wish to change your mind later.) If you've

marked an objective as being both skill-based and knowledge-based, don't eliminate it. Objectives which can be categorized in this way usually have components for which CBT is quite effective. Some of these features will be considered later in the following sections of Decision A.

Conditions

Objectives that require special training settings, environmental conditions, or operational equipment may not be suitable for CBT. Examine those objectives which you have identified as requiring unusual or highly specialized conditions (marked in the "Conditions" column). Draw a line through those objectives which you determine should be eliminated from consideration based on this criterion. Keep in mind that CBT is able to simulate the conditions found on most jobs. For those few objectives which have unique conditions, consider training some of the enabling objectives using CBT.

Standards

As mentioned above, certain behavioral measurements are difficult, if not impossible, to obtain in CBT testing environments, e.g., amount of time (or speed) one takes to dismantle an engine, or the accuracy of hitting a target at increasing distances. Other objectives which require assessment of psychomotor skills or attitudes, e.g., deploy team, configure personal equipment, field-strip and reassemble an M-16 rifle, and demonstrate respect for the flag may not be appropriate for this delivery medium. But all of the knowledge required to perform these tasks can be taught very effectively by CBT.

Review the "Standards" column on the worksheet. Objectives identified as falling in this category are probably not acceptable candidates for computer-based training. Before eliminating an objective, consider the enabling objectives which support it. Some of these may be candidates for CBT. After consideration, draw a line through the objectives which you are eliminating.

Optional Objectives

Objectives which are an optional component of an instructional system may meet needs which are different than those objectives that are mandatory. For instance, an optional objective may serve as a means of remediation for students who are not performing to standards or may offer enhanced or accelerated instruction for students who are performing very well. In addition, the number of students receiving optional instruction may be significantly less than the number of students exposed to the required curriculum.

If cost is a factor, it may influence your decision to implement CBT for these objectives. Review the optional objectives with these issues in mind. Don't eliminate these objectives from consideration now. After you have computed the cost of CBT in Decision X, you may wish to return and eliminate some or all of these optional objectives to lessen the costs somewhat.

Changes to Objectives

Changes to an objective will affect the content, and sometimes, the design and delivery of instruction. Therefore, changes to an objective being considered for delivery via CBT may have far reaching effects in terms of hardware and software support, instructional design, and so on. In light of this, a decision to implement CBT for an objective which is in a state of flux should be postponed until the objective has been conclusively stated. The cost of CBT increases significantly if the objective is going to constantly need to be changed. For this reason, those objectives which have been identified in the "Changes" column may need to be eliminated from consideration. Draw a line through the objectives you judge as being in this group.

Remember, objectives which change frequently can be a burden to change once CBT is implemented. Choose them with caution, but don't eliminate an objective from consideration for CBT on this basis alone. An objective which is extremely critical, yet changes frequently, may still need to be considered for CBT because of its criticality. External factors such as this may need to be considered by your organization in finally determining which objectives to develop in CBT. Make note of these factors next to the objective(s) on the worksheet.

Worksheet A
Section 2

In the first section of Worksheet A, you eliminated some of your objectives from consideration for CBT because some of the learning characteristics were not appropriate for CBT. In Section 2 of Worksheet A, you will be narrowing down the specific CBT requirements even more by eliminating those objectives for which the type of training and the instructional setting tend to make CBT an inappropriate medium. Work through those objectives which you have listed and not "lined out," checking the appropriate boxes on this section of the worksheet. Follow the specific instructions below. To complete this section, use Section 2 of Worksheet A. Consider those objectives which have <u>not</u> already been lined out or eliminated.

Section 2 Instructions

1. Refer to question 14 on the Questionnaire. If the answer is **Yes**, identify those objectives which require actual on-the-job training by placing a check mark in the column headed "On-the-Job."

2. Refer to question 15 on the Questionnaire. If the answer to this question is **Yes**, identify those objectives which rely upon a simulation of the total job environment for training by placing a mark in the column headed "Vestibule."

3. Refer to question 16 on the Questionnaire. If the answer is **Yes**, identify those objectives which must be trained in the field by placing a check mark in the column titled "Field."

4. Refer to question 17 on the Questionnaire. If the answer to this question is **Yes**, identify those objectives which must be trained using the apprenticeship or assistantship method by placing a check mark in the column titled "Apprenticeship."

5. Refer to question 18 on the Questionnaire. If **option a** is selected, these objectives should be primary candidates for CBT.

   If **options b or c** are selected, consider the following:

   Is this instructional setting required for objective achievement?

   If the answer to this question is **Yes**, identify those objectives affected by placing a check mark in the appropriate column ("Simulator" or "Laboratory").

6. Review the **Interpretation** for Section 2. Based on the guidance there and the information from the blocks you have just checked, line out those objectives for which CBT is not appropriate because of the type of training or the instructional setting.

Section 2 Interpretation

Type of Training

For each of the types of training listed on this worksheet (on-the-job, vestibule, field, and apprenticeship), certain physical settings and levels of personal interaction are inherent to the training system. For instance, in on-the-job training, an operational workplace setting is generally used, as well as direct interaction with an experienced job incumbent. In vestibule training, the job environment is replicated, but without the production or performance pressures typically found at the job site. The student is trained by experienced personnel in this simulated setting. Field training actually represents a type of on-the-job training, with the instructional setting more narrowly defined. In apprenticeship or assistantship training, the trainee works under the direction and supervision of a skilled individual for a prolonged period of time. While this type of training is also similar to on-the-job training, it differs in that the training regime is less formal while the skill levels are generally well defined.

Frequently, these types of training are not good candidates for CBT because: (1) the instructional setting usually cannot be replicated via computer or may be inappropriate for housing a CBT system, or (2) the level of interaction between the trainee and the instructor is usually high and involves subliminal training that is difficult to achieve with CBT. The key point to consider is that CBT can emulate many conditions to a lesser degree of fidelity than is actually found on-the-job. If CBT can be used to achieve a portion of the training requirements, do not rule the objective out.

As you review those objectives with marks in these four columns, consider these criteria. However, as with the skill-based objectives, keep in mind that enabling objectives associated with terminal behavior taught in these settings may be appropriate for computer-based instruction.

If there is no way that CBT can be used to simulate the type of training for all or part of the objective, draw a line through those objectives which should be eliminated based on the type of training required.

Required Instructional Setting

Generally, most objectives taught in the classroom can be candidates for CBT. However, when the training requirements specify another instructional setting to facilitate objective achievement, the conversion or hosting of the instruction on the computer becomes more difficult. For example, although computers are integrally involved in most simulators, the training environment is altered by the simulator, sometimes dramatically. Likewise, in a laboratory setting, there are often environmental factors and equipment that cannot be replicated by the CBT medium. The same is true for some experiences found in field training. Keep in mind that CBT can be used to present numerous color, sound and other visual stimuli which might be the necessary ingredients used in a laboratory setting. CBT cannot replicate stimuli which are required for training the senses of smell, taste or touch. Separate out those objectives which can make use of CBT from those which cannot.

If simulator, laboratory, or field training is required for an objective, consider these environmental factors when selecting objectives for elimination as CBT candidates. Again, remember that, while terminal objectives may not be well suited for CBT, the supporting or enabling objectives may be appropriate for CBT and should be selected. Draw a line through those objectives which should be eliminated based on the nature of the required instructional setting.

Worksheet A
Section 3

The issue considered in Section 3 of Worksheet A is the type of learning environment and interaction with that environment necessary to achieve the objectives under consideration for CBT implementation. A distinction is being made here between the instructional setting and the learning environment. Earlier, in Section 2, the instructional setting was defined in terms of applicability to a CBT instructional setting. The focus was on the type of training and the physical setting where training takes place. Here, the perspective has shifted to those things (equipment, exhibits, exercises) that alter the student's learning environment. These items may or may not change the instructional setting; therefore, they are being addressed separately.

The guidelines set out below will help you to further eliminate those training requirements or objectives which are not amenable to CBT. To complete this section, use Section 3 of Worksheet A. Consider those objectives which have not been lined out or eliminated.

Section 3 Instructions

1. For this section of Decision A, refer to those columns designated "Section 3." Consider only those objectives not eliminated in Sections 1 or 2.

2. Refer to questions 9 and 10 on the Questionnaire. If you have indicated in question 9 that equipment is used as part of the instruction, (i.e., you circled any letter except "f"), and you also indicated that this equipment is used for practice, (i.e., circled "a" in question 10), and the student must use the actual equipment to master the objective, then identify the objectives affected by placing a check in the column headed "Required Equipment."

3. Refer to question 19 on the Questionnaire. If the answer to this question is **Yes**, identify those objectives which **require** laboratory equipment by placing a check mark in the column entitled "Required Equipment."

4. Refer to questions 21 and 22 on the Questionnaire. If the answer to question 21 is **Yes**, and the answer to question 22 is either **b or c**, then identify those objectives which require the use of mockups, models or exhibits for objective achievement by placing a check in the column headed "Hands-on."

5. Refer to question 23 on the Questionnaire. If the answer to this question is **Yes** and the use of this equipment is **required** for the achievement of the objective, place a check mark in the column titled "Required Equipment" to identify those objectives which are affected.

6. Refer to questions 11, 20 and 24 on the Questionnaire. If the answer to any of these questions is **Yes** and it is essential that the students practice with these graphics, exhibits or projected images, identify the objectives which will be affected by these plans by placing a check mark in the column entitled "Plans."

7. Review the **Interpretation** for Section 3. Based on the guidance provided there and the information from the blocks you have just checked, line out those objectives for which CBT is not appropriate because of specific, hands-on, equipment requirements.

Section 3 Interpretation

As mentioned previously, there are a variety of learning or training aids that can potentially alter a student's learning environment. Some of these include hardware-type aids: operational equipment, simulators and part-task trainers. There are also "soft" aids such as games and role playing. Generally, those learning aids which involve interaction with hardware devices can only be partially implemented in CBT. A typical example of this would be a case in which the student is learning about the equipment. Games, role playing and two-dimensional simulations are candidates for CBT and objectives utilizing these techniques should be considered for CBT.

Required Equipment/Exhibits

Although equipment or exhibits may be a required part of the instruction, that factor by itself does not eliminate that portion of the instruction from inclusion in a CBT system. The type of interaction the student must have with the equipment or exhibit is the important factor. For example, if the equipment is used for demonstration purposes only, this training requirement may be met with high quality images. However, if "hands-on" interaction is required, chances are that some of this cannot be supported with CBT.

Review those objectives identified in the columns titled "Required Equipment," and "Required Exhibits." Draw a line through those that you determine require an alteration to the learning environment based on the above criteria.

Plans

Some consideration should also be given to proposed or planned changes to the learning environment. If changes to a course include the use of simulation or other hands-on equipment, this should be taken into consideration in assessing the objective for CBT. As an example, it may be planned to develop a simulator to be used for training/testing of students. However, there may only be sufficient funding to acquire one or two of these devices when, in reality, several more are needed. CBT can be used quite effectively as a lower-degree-of-fidelity simulator to help alleviate any training bottlenecks which may result because there are not enough devices.

Worksheet A
Section 4

There are three additional areas to be considered when determining whether CBT is an appropriate medium for your training requirements. First, the level of standardization or consistency between classes teaching the same objectives is important. A second consideration deals with the delivery method required to help the student master the objective. The computers used in CBT can support a number of delivery methods from lecture to demonstration to gaming; however, others are not possible. A third consideration is interaction -- how much is required? The following guidelines will help you identify these characteristics of the objectives under

review. To complete this section, use Section 4 of Worksheet A. Consider those objectives which have not been lined out or eliminated.

Section 4 Instructions

1. Refer to question 5 on the Questionnaire. If the response is **2 or 1**, place a check in the column titled "Content" for each objective where there is little or no standardization.

2. Refer to question 6 on the Questionnaire. If the response is **2 or 1**, place a check in the column headed "Method/Material" for each objective where there is little or no standardization.

3. Refer to questions 25, 26 and 27 on the Questionnaire. If the instructional methods used in the course are not appropriate for CBT, or the objectives can be handled more effectively by some other method, the objectives should be identified here. If the responses to questions 25 or 26 circled letters **e, g, j, k, l,** or **m**, you should review those objectives to see if some other media would be more effective, i.e., videotape, intelligent tutoring system, etc. Remember that IVD may be able to be used for some of these methods. If options **j or k** are selected for question 27, identify the objectives which rely on these methods of delivery by placing a mark in the column entitled "Required Delivery Method."

4. Refer to question 28 on the Questionnaire. If the answer to this question is **No**, identify those objectives that cannot be mastered without some type of active interaction by placing a check mark in the column titled "Active."

5. Refer to question 29 on the Questionnaire. If the answer to this question is **Yes**, identify those objectives for which the student must be able to ask questions and receive a response (i.e., intelligent interaction) by placing a check mark in the column entitled "Questions."

6. Refer to questions 30 and 31 on the Questionnaire. If the answer to either of these questions indicates the need for an instructor, identify those objectives which require high instructor involvement by placing a mark in the column headed "Instructor."

7. Review the **Interpretation** for Section 4. Based on the guidance provided there and the information from the blocks you have just checked, line out those objectives for which CBT is not appropriate because of the factors considered here.

Section 4 Interpretation

Standardization

The level of standardization across or between classes teaching the same objectives is important because, although CBT can be designed to offer several different presentations of the same objective material, the pool of presentations is finite and only as varied as the designer specifies. CBT can be designed to meet the needs of a variety of students through branching and remediation; fundamentally, the content, instructional material, delivery method, and supporting materials are the same. A check mark in the "Content" column or "Method/Material" column indicates that the current instruction is not very standardized. If this instruction (the content, methods, or materials) cannot be standardized, hosting the instruction on the computer will be difficult and will constantly present a courseware maintenance problem. After considering the ability to standardize the objectives marked in the "Content" and/or "Method/Material" column, omit from consideration those that cannot be standardized.

Required Delivery Method

At times, a particular delivery method is required for the student to understand and achieve the objective. While CBT can meet many of these needs, sometimes it cannot. If an objective has been marked in the "Delivery Method" column, this is an indication that the training requirements rely upon an instructional delivery method that cannot be supported with CBT. In this instance, indirect discourse, teaching interview, student query, the seminar approach, the performance method and case studies have been identified as methods which may not be suitable for computer-based instruction. If, after further review, the objective does indeed rely upon these instructional methods, it should be eliminated from consideration (draw a line through the omitted objective). For an explanation of the various instructional delivery methods see the chart in the Questionnaire (p. 8).

Interaction

Three issues that influence the level of interaction required for a student to achieve an objective are: (1) active versus passive learning; (2) questioning by the student; and (3) amount of instructor involvement. CBT can provide for interaction and student control through the design; however, it does have some limitations.

With regard to active versus passive learning, CBT frequently presents some form of verbal instruction, whether it is written text, audio material, or some combination. CBT also has the capability to present purely visual information in the form of graphics, tables, photographs, animation and motion video. If the training requirements mandate that the student be actively involved to achieve understanding (e.g., assemble/disassemble equipment, write an essay, repair operational equipment, perform a salute) a portion of the objective may not be suitable for CBT. However, CBT can provide a simulated environment in which the student can learn many (almost

all) of the steps involved in these types of tasks. In addition, with proper utilization of CBT, the student's active participation in the learning process makes a huge leap forward. By simulating the actual equipment and/or operational environment on the two-dimensional computer screen, the student is immediately acclimatized to the environment while he/she is still in control (i.e., a high degree of information/knowledge about the environment passes on to the student in a "low threat" situation). Next, by the student having control of the learning activity, he/she will tend to focus on those portions of the task that he/she actually does not know. Traditional instruction rarely affords this opportunity in a classroom setting; and in the one-on-one situation of OJT, there are frequently too many distractions. Finally, the student is able to gain confidence in performing the task by practicing several times in the same "low threat" environment. We know that the final checks on such learning must come when the student performs and is evaluated on the task using the actual equipment in an operational setting (i.e., the maintenance technician disassembles the equipment, the basic trainee salutes properly, the student pilot successfully completes a checkride, etc.). If there are objectives which you have classified as "active," parts of which can be simulated by CBT, make note of this in the remarks column. You should revise these objectives to reflect the use of CBT for the enabling objective and the "active" component. Only those portions of the objective which require the specialized performance, e.g., salute, pass checkride, etc., should be eliminated from consideration for CBT.

Another type of interaction is student query. Some level of student query capabilities can be designed into a system, but like the standardization issues, the capabilities are finite. The student usually must ask a previously defined question in order to gain a response. If the student needs to be able to ask free form questions and receive a response, CBT is not the appropriate medium, and should probably not be considered. A much more sophisticated intelligent tutoring system is needed to allow for the use of these higher level features.

Instructor involvement is another type of interaction that needs to be considered. If the need for instructor involvement or modeling of instructor behavior is high, then CBT may not be appropriate for that objective. For example, if a secondary goal of the training is to learn how an Air Force officer should behave, CBT may not be able to meet this need as well as the student's observation of an instructor. But this does not preclude the use of CBT along with an instructor to achieve a portion of the objectives.

For each objective which is identified under the heading "Interaction," consider these criteria. After making your decision, please draw a line through any objectives you determine should be eliminated from consideration.

Decision A Worksheet Output

The objectives which have not been eliminated or crossed out are those that are likely candidates for inclusion in a CBT system. This is not to say that these are the only objectives which can be delivered via CBT - just that these are best suited for CBT.

You should keep Worksheet A with all of the information which is recorded on it as part of the record of your analysis. Others will be able to see the rationale for your decision regarding the implementation of CBT because of this documentation.

DECISION B
Deliver Instruction Via CBT

Whether or not to deliver instruction via CBT can be a difficult decision to make. Several factors should be considered in making the decision. Included on this worksheet are some of the more important considerations, such as the amount of instruction that "qualifies" as candidate for CBT development, the number of students who benefit from the instruction, and how often the instruction is provided.

At this point, having completed Part I of the Questionnaire and Decision A, you should have a fairly good idea of your training organization's setting, requirements, and current capabilities. After completing Decision B, you will be able to determine whether or not CBT can benefit your organization. If so, you will need to complete the rest of these guidelines. If CBT is not indicated, you can stop after completing this section.

Complete Worksheet B according to the instructions provided below. Upon completion, you should consult the section titled **Interpretation** for a more detailed explanation of each item and the responses.

Instructions

1. Estimate the total number of instructional hours for the instruction being considered for CBT development and delivery. This number is the total of all hours of the objectives listed on Worksheet A, including those which have been lined out through the Decision A process, i.e., the total number of hours of instruction being considered, i.e., your course. Enter that total in the space provided on Worksheet B. Of that total, estimate the number of instructional hours considered to be CBT candidate hours. This number will be the total number of hours of those objectives on Worksheet A which have NOT been crossed out. Divide the CBT candidate hours by the total hours. Express the result as a percent.

2. Refer to question 1 on the Questionnaire. From the choices provided, select the frequency (monthly, quarterly, semi-annually or annually) that most nearly describes the frequency with which the instruction is currently delivered. Enter the total number of students receiving the instruction in the box beside the frequency selected.

3. Refer to question 4 on the Questionnaire. If the answer to question 4 is **a**, you will need to estimate whether these students will be able to adapt to a course using CBT. This factor should be very important in considering implementing CBT.

4. Review the outcomes of Items 1 and 2 on Worksheet B in conjunction with the Interpretation section, and decide if CBT is positively indicated. If it is, proceed to the Questionnaire, Part II. If not, you should stop now after completing Decision B.

DECISION B
Deliver Instruction Via CBT

1. Percent of CBT Candidate Hours

_____ divided by _____ = _____%
CBT Candidate Hours — Total Hours

2. Number of Students and Frequency of Instruction

Number of students receiving instruction: _____ Monthly _____ Semi-annually

_____ Quarterly _____ Annually

DECISION B
Deliver Instruction Via CBT

Interpretation

The Decision B worksheet is designed to assist you in deciding whether the instructional setting characteristics generally lend themselves to instructional delivery via CBT technology. From the information assembled through the worksheet, you should be able to gain an impression of the setting and decide if further pursuit of CBT is worthwhile. The factors used in the worksheet and the interpretation data follow:

Percent of CBT Candidate Hours

For the purposes of the worksheet, CBT candidate hours are compared to total instructional hours; the result indicates the relative amount of instruction that is candidate for CBT delivery. The higher the percentage, the stronger the case for delivery via CBT. Several factors must be taken into consideration when examining this information. First, even if the candidate hours are a high percentage of the total course hours, CBT may not be warranted due to other factors. Is the course of such a low impact, i.e., few students, that the development of CBT would not have a positive effect from a cost standpoint? (We will consider the cost of CBT in Decision X.) Are either the faculty or the students so "computer-naive" that CBT would cause more problems than it is worth? Second, even if the candidate hours are a very low percentage of the total course hours, CBT may still be indicated. Are these objectives critical and in need of standardization? Then CBT may be warranted. You should consider such factors as these before ruling out (or ruling in) CBT because of the percent of the course affected.

Number of Students and Frequeny of Instruction

An important economic consideration concerns sufficient numbers of students receiving instruction on a frequent enough basis to justify a CBT system. It is generally agreed that these two factors must be considered together to form the basis of the decision. While a decision may be made solely on the basis of the combined information derived from these two factors, some instances may demand that other factors also be considered, such as criticality of the instruction. For example, instruction may be provided to only a few students on an infrequent basis; however, the nature and the need for the instruction may be sufficiently critical to justify delivery via CBT. Generally speaking, the greater the number of students and the greater the frequency of instructional delivery, the stronger the case for instructional delivery via CBT. If the combined result of these two factors is low, consider the criticality of the instruction before completely ruling out CBT delivery.

This is a Yes/No decision regarding CBT. You must complete the rest of the sections of these guidelines in order to answer the rest of your questions about CBT. If CBT is indicated, the specific ways in which you will be able to implement it will be worked through in the rest of

these guidelines. In other words, the completion of this document will help your organization formulate a plan for acquiring and implementing CBT. If CBT is not indicated, you have finished using this document.

Please STOP here.

If you have sufficient reason to proceed with CBT based on Decisions A and B, go to Part II of the Questionnaire and begin answering questions starting with question 32. If CBT is <u>not</u> indicated, you should STOP. You have finished using these guidelines.

General Instructions

Before beginning to work on Decisions C through X you should complete Part II of the questionnaire (Part II begins at question 32). Once again, you are reminded that the following decisions are only necessary if you have already decided that CBT technology is appropriate for your training requirements. Once you have completed Part II of the Questionnaire, you should work through Decisions C through X. The Roadmap which appears at the beginning of this document shows the relationships among the individual decisions. Usually, it is advisable to work through the decisions in the order listed in this document. There may be specific points for which you will need some assistance in answering a question or completing a worksheet. You should not hesitate to involve others in your organization in assisting you with these decisions.

Complete Part II of the Questionnaire, then go on to Decisions C through X. When you have completed all of the remaining sections of these guidelines you will have almost all the information required by your organization to plan for the acquisition and implementation of CBT. Some of the information which you will use in the worksheets and decisions will be used to select the right CBT system for your organization and some will be used to determine if you can or cannot accomplish a function within your organization. Some of the information will be used to complete specifications which can be used by your organization to acquire hardware, software or services for CBT, and still other information will make you aware of changes which will result from CBT implementation for which your organization must be prepared. All of the information asked for in this document serves some purpose in CBT planning, selection or implementation.

DECISION C
Student Needs

This section has a three-fold purpose: 1) to collect information about the number of students using CBT; 2) to alert you to potential student needs, and 3) to suggest some steps which may be taken to address them. The first two sections of Worksheet C ("Single Class" and "Multiple Classes") serve as a central location in which information about numbers of student users may be consolidated. The third section of the worksheet ("Typical Student Profile") provides you with a brief picture of your students' characteristics. The interpretation for Worksheet C will address ways of handling your student needs based on the characteristics recorded in the third section.

Instructions

1. Single Class. Refer to questions 38, 39, and 40 on the Questionnaire. From these questions, write the number of students indicated for Items 1, 2, and 3 on Worksheet C. The numbers in brackets [ ] correspond to specific question numbers on the Questionnaire from which the information should be transferred.

2. Multiple Classes. Refer to question 44 on the Questionnaire. Write the average number of students per class in the space provided for Item 4 on the worksheet. Refer to question 43, and write the number of classes held at any one time in the space for Item 5. Multiply the numbers you listed for Items 4 and 5. Write the answer in the space provided for Item 6. If there are no multiple classes expected to use CBT at the same time, write NA (not applicable) in these blanks and go on to step 3, below.

3. Typical Student Profile. For Items 7-13 on Worksheet C, transfer your answers from the Questionnaire to the appropriate spaces on the worksheet. The corresponding question numbers are indicated in brackets [ ].

DECISION C
Student Needs

Single Class

1. Number of students per year [38] ..... _____
2. Average # of students per class [39] ..... _____
3. Average # of students who would be using CBT at any one time [40] ..... _____

Multiple Classes

4. Average # of students per class [44] ..... _____
5. Number of classes held at any one time [43] ..... _____
6. Average # of students who would be using CBT at any one time (Multiply Item 4 by Item 5) ..... _____

Typical Student Profile

7. Age [32] ..... _____
8. Rank [33] ..... _____
9. Educational Background [34] ..... _____
10. Level of motivation for course [35] ..... _____
11. Extent of computer experience [4] ..... _____
12. Degree of variation among incoming students [36] ..... _____
13. Changes expected to student profile? [37] ..... _____

DECISION C
Student Needs

Interpretation

Number of Students and Class Size Data

Data on the number of students who will be using CBT at any one time, and other data related to the number of students per class are recorded here for use throughout the rest of this document. You will not make use of these data now, but the guidelines will refer back to them again and again. For example, you will need this information to calculate the number of student terminals needed by your organization.

Typical Student Profile

The eventual success of your planned CBT system may be determined by the degree to which you tailor the system to your students' needs. For example, students who are not at ease with computer technology need to be treated differently from students who are comfortable with using the computer. Failure to do so may diminish the effectiveness of an otherwise well-planned system. This interpretation is intended to relate student characteristics from the Typical Student Profile section of your worksheet to three specific areas which you may need to consider as you implement CBT--computer anxiety, motivation, and reading level.

This information may also be used again, if you need to build a specification which describes for a contractor what your typical student may be like. This information should be supplemented with as much information about the typical student as possible. It is usually the case that the more the contractor knows or is provided, the more accurate his cost estimate will be.

Computer Anxiety

In general, students who are older (regardless of educational background or rank) and who have had little or no exposure to computers tend to be afraid of computers. Younger students with little or no exposure to computers also tend to be afraid of computers at first, but seem to be able to overcome their fears more easily. If you know that some students will have little or no background in the use of computers, and especially if you know that they are older, you will need to devise ways to alleviate their anxiety. These may include directly addressing the issue of computer anxiety, keeping input methods simple, use of humor and graphics--and just generally minimizing the likelihood of something about the computer making them feel helpless, inadequate, or not in control.

Motivation

Often student motivation for a course increases with the use of CBT--at least initially. This occurs simply because of the novelty of the medium. However, keeping student

motivation high for the duration of a long course requires effort and planning. Some measures that can be taken to achieve and maintain a high level of student motivation include structuring the schedule so that students do not have to use CBT for several hours at a time, or by use of humor and graphics within lessons. Maximizing interaction between the student and the instruction also increases interest and motivation, and can be achieved through frequent use of questions, gaming, and most particularly through simulations. The most effective tool in achieving student interest and motivation is the quality of the instruction. If the CBT teaches the student about some topic, there will be less of a requirement for attention getting devices to be inserted into a lesson.

Reading Level

Knowing the educational background of your students gives you an indication of their reading level. Nearly all CBT requires students to read material from the screen. It is possible for a CBT lesson to be ineffective solely because it is written at an inappropriate reading level. Therefore, knowing your students' reading level, and tailoring your instruction appropriately, is critical. Students with lower reading levels can be taught very effectively using CBT. Because of its ability to simulate equipment and the job environment, CBT can meet the needs of students who have difficulty reading.

Some Additional Considerations

Computer background, motivation, and reading level will vary somewhat for all students. Most of the time, it will be sufficient to try to meet the needs of the majority. However, if variations are serious and persistent (e.g., half the class always read well, and half the class always read poorly), you may need to think of ways to tailor the instruction to specific student needs. This may include designing the instruction to offer "multiple tracks" to accommodate different levels of student ability or performance. Designing instruction so that it is tailored to specific individual needs (to some degree) can be expensive, and should be undertaken judiciously, but is actually the essence of good CBT.

When designing and developing instruction to accommodate current student characteristics, consider the effects of possible change. Future students may be more computer literate, less motivated, or worse readers than the current group. If you expect changes to your student profile, then you should plan to accommodate those future needs accordingly.

DECISION D
Staff Needs

CBT development is a multi-faceted process requiring personnel with technical as well as instructional skills. Your organization's ability to successfully develop and/or maintain CBT depends on the capability (i.e., depth of experience) and the availability of personnel with these skills. For the purposes of these guidelines, six types of skills are assumed to be necessary for CBT development:

1. Courseware design/development
2. Computer programming/courseware authoring
3. Video production
4. Graphics production
5. Computer systems support
6. CBT project management

How these skills are divided up depends on the size of the project and the resources available. Smaller projects often require development team personnel to wear several "hats."

The purpose of Worksheet D is to allow you to consolidate information about your staff on a single form so that you can get a rough estimate of their capability and availability to perform certain CBT design, development, and maintenance tasks. You will generate three separate measures of staff capability/availability to perform activities of in-house design, maintenance of CBT materials, and maintenance of CBT software and hardware. This information will also serve as an aid to you in completing Worksheets F and G.

Instructions

1. Complete Item 1, "General Computer Familiarity," on Worksheet D by writing in the response to question 123 from the Questionnaire.

2. For Item 2, "Courseware Design/Development," refer to question 110. If four or more of the options listed have been circled, write a 3 in the "Capability" column. If two or three of the options listed have been circled, write a 2 in the "Capability" column. If one option (other than option "f") has been circled, write a 1 in the "Capability" column. If option "f" was circled, write a zero. Also, write the number of man-years per year courseware development personnel would be available to you from question 111 in the "Availability" column, if applicable. Take into account what they are doing now and if

they would still be required to do it. You must be quite realistic in answering these questions or the guidelines will not be of use to your organization.

3. For Item 3, "Computer Programming/Courseware Authoring," refer to question 112. If five or more of the options listed have been circled, write a 3 in the "Capabilities" column. If two to four options have been circled, write a 2 in the "Capability" column. If one option (other than option "l") has been circled, write a 1 in the "Capability" column. If option "l" was circled, write a zero. Also write the number of man-years per year of computer programming or courseware authoring personnel would be available to you from question 113 in the "Availability" column, if applicable.

4. For Item 4, "Video Production," refer to question 114. If three or more of the options listed have been circled, write a 3 in the "Capability" column. If two of the options listed have been circled, write a 2 in the "Capability" column. If one option (other than option "e") has been circled, write a 1 in the "Capability" column. If option "e" was circled, write a zero. Also write the number of man-years per year of video production personnel time would be available to you from question 115 in the "Availability" column, if applicable.

5. For Item 5, "Graphics Production," refer to question 116. If three or more of the options listed have been circled, write a 3 in the "Capability" column. If two of the options listed have been circled, write a 2 in the "Capability" column. If one option (other than option "e") has been circled, write a 1 in the "Capability" column. If option "e" was circled, write a zero. Also write the number of man-years per year of graphics production personnel time would be available to you from question 117 in the "Availability" column, if applicable.

6. For Item 6, "Computer Systems Support," refer to question 118. If four or more of the options listed have been circled, write a 3 in the "Capability" column. If two or three of the options listed have been circled, write a 2 in the "Capability" column. If one option (other than option "f") has been circled, write a 1 in the "Capability" column. If option "f" was circled, write a zero. Also write the number of man-years per year of computer systems support personnel time would be available to you from question 119 in the "Availability" column, if applicable.

7. For Item 7, "CBT Project Management," refer to question 121. If there are personnel available who have previously managed all phases of a CBT development effort, i.e., from requirements analysis through the installation and maintenance of the course, write a 3 in the "Capability" column. If there are personnel available who have managed major portions of the effort to develop CBT, but have not managed a complete effort, write a 2 in the "Capability" column. If there are personnel available who have managed some small portion of a CBT development effort, write a 1 in the "Capability" column. Otherwise, write a 0 in the "Capability" column. Also write the number of man-years for

each year of CBT project management personnel time that would be available to you from question 122 in the "Availability" column, if applicable.

8. Item 8 is intended to help you obtain a rough measure of your staff's ability to produce CBT in-house. To get a measure of your staff's level of capability for CBT development in-house, add the individual ratings numbers written in the "Capability" column for Items 2 through 7, and divide the total by 6. Round the result to the nearest whole number, and write this number in the blank marked "Capability" in Item 8. If the rating is 3, you should have no trouble producing CBT in-house. If the rating is 2 you will be able to produce the CBT in-house but there may be several things which must be done first in order to enable your organization to do so. If the rating is 1 you will definitely encounter problems if you attempt to develop CBT in-house. If the rating is 0 you should definitely not attempt any in-house CBT program. Plan to get contractor support.

9. To get a measure of the staff size available to you for CBT development in-house, add the numbers written in the "Availability" column for Items 2 through 7. Write the total in the blank marked "Availability" in Item 8. Later, you will calculate the number of staff required to develop CBT in-house. You will then be able to compare the number of staff required with the number of staff available to determine whether your organization is capable of undertaking a CBT development effort with the existing staff.

10. Item 9 is intended to help you obtain a rough measure of your staff's ability to maintain CBT instructional materials after they have been produced. To get a measure of your staff's capability for maintaining CBT instructional materials, add the numbers written in the "Capability" column for Items 2 and 3; and divide the total by 2. Round the result to the nearest whole number and write this number in the blank marked "Capability" in Item 9.

    To get a measure of the staff available to maintain instructional materials, add the numbers written in the "Availability" column for Items 2 and 3. Write the total in the blank marked "Availability" in Item 9.

11. Item 10 is intended to help you obtain a rough measure of your staff's ability to maintain the CBT hardware and software after the system has been installed. To get a measure of your staff's capability for maintaining CBT hardware and software, look at the numbers written in the "Capability" column for Item 6. Write this number in the blank marked "Capability" in Item 10.

    Note: It usually requires less skill to maintain a CBT system once it has been installed than the skill required to implement CBT. Evaluate your staff carefully. If they indicate that they will be able to support a CBT system, then you may be able to do so, especially with help and training provided during CBT implementation. If your staff will not be able to support the CBT system, you need to begin planning for contractor support throughout the life-cycle of the CBT system.

To get a measure of your staff's availability for maintaining instructional materials, refer to the number written in the "Availability" column for Item 6. Write this number in the blank marked "Availability" in Item 10.

DECISION D
Staff Needs

Computer Literacy

1. General computer literacy [123] ..... _____

Staff Capabilities and Availability

		Capability	Availability
2.	Courseware Design/Development	_____	_____
3.	Computer Programming/ Courseware Authoring	_____	_____
4.	Video Production	_____	_____
5.	Graphics Production	_____	_____
6.	Computer System Support	_____	_____
7.	CBT Project Management	_____	_____

General Indicators of Staff Capability/Availability

		Capability	Availability
8.	Ability to produce CBT in-house	_____	_____
9.	Ability to maintain CBT instructional materials	_____	_____
10.	Ability to maintain CBT hardware and software	_____	_____

DECISION D
Staff Needs

Interpretation

The following interpretation is intended to help you interpret the Worksheet D responses. After reading this part, you may want to review and readjust some of the responses (ratings) you wrote there. You will use the results of Decision D in later worksheets. In particular, Worksheet F makes use of the data derived here to evaluate your organization's ability to develop the CBT in-house.

General Computer Literacy

The general level of computer literacy among your staff members is a very important consideration, because it can affect the success of many of your CBT implementation decisions. CBT is a highly technical training tool which requires a variety of skills to implement successfully; a staff that is already computer literate has fewer obstacles to overcome.

An organization can be considered computer literate if most (greater than 50%) of its staff use computers on a regular basis. Personnel who are at ease with using computers as a tool (for word processing, spreadsheets, data bases, etc.) will probably have little trouble with the mechanics of learning how to program a CBT lesson. It is also helpful if personnel have had some previous exposure to CBT.

If your staff is not very computer literate, you will need to make a special effort to facilitate your organization's use and acceptance of CBT. Lack of computer proficiency can slow the progress of a project; excessive fear and anxiety can kill it -- or at least make it a lot less successful. If CBT systems will be perceived as a potential threat by some members of your staff, it is important to recognize such problems early and take steps to prevent or alleviate them. Actions you might take include (but are not limited to) sending staff members to classes or seminars, subscribing to computer and CBT-related publications, circulating sample CBT courseware, and simply keeping everyone "in-the-loop" with regard to what is being planned.

Staff Capabilities and Availability

This section is designed to allow you to evaluate your staff in terms of depth of experience and availability of skill in six CBT skill areas. The rankings of capability (from 0 to 3) are intended to give you an estimate of their depth of skill in the broadest possible terms. A staff with ratings of 3 in all or most of these six areas can take on almost any CBT related project and do well (assuming it is not undermanned for the task).

However, depending on your particular need, you may not require a "3" rated skill in every area. For example, in the area of Programming/Courseware Authoring, if members of your staff are already familiar with the authoring software you will be using, it matters less how many other languages or packages they know. Another example would be that if your CBT requirements do not include use of video, you do not need to have depth of skill in the area of video production.

Look over the figures in the "Availability" column for Items 2-7. Make sure that you have not overestimated the amount of time personnel with each type of skill will be available for your project. If a single individual will be working in more than one area (i.e., "wearing more than one hat"), for example, don't count him or her as being available full-time in each area. Instead, use fractions to indicate what portion of his/her time will be spent in each area. Make changes as necessary.

General Indicators of Staff Capability and Availability

This section combines information from the previous sections to come up with some measures of an organization's capability to produce instruction, to maintain CBT instructional materials, and to maintain CBT hardware and software. This information will be used (in combination with several other factors) in helping you make decisions about performing work in-house or contracting it out.

Ability to produce CBT. Producing CBT is a major endeavor frequently requiring skills in all six areas. To obtain a measure of your staff's ability to produce CBT, you were asked to average the capability ratings from all six areas. (It is assumed here that you will utilize both graphics and video in your CBT system; if this is not true, then you should omit them from the averaging process.) A score of 3 indicates that you have a staff that is capable of handling a broad variety of CBT production tasks. A score of 2 indicates that your staff is probably able to produce CBT, but it is somewhat limited in what it is able to do on its own. A score of 1 indicates that your staff probably needs help in some or all areas before it can produce CBT. A score of 0 indicates that your staff is not ready to produce CBT. This is only a general estimate of capability. You must decide if the staff can do it. Don't get them into a project for which they are not really qualified! Also, just because the staff is qualified doesn't mean that they will have enough time to do all of the work required to implement CBT. Be realistic in your estimate of the time they are available.

Ability to maintain CBT instructional materials. This indicator is intended to measure your organization's ability to make revisions (e.g., updates, corrections) to CBT material after it has been produced. It is possible that an organization may require assistance to produce CBT, but be quite capable of maintaining the instruction alone afterwards. To obtain this measure, you were asked to average the capability ratings in the areas of "Courseware Development" and "Computer Programming/Authoring." (It was assumed that these are the areas of skill most pertinent for instructional revision. However, if you

know you will need to utilize skills from one or more of the other areas in maintaining instructional materials, you could average them with the others.) A score of 2 or above indicates that your organization has the skills to maintain CBT instructional materials with relatively little trouble. A score of 0 or 1 indicates that you will probably encounter serious problems without some assistance. Once again be realistic in your estimate of the time that the staff will have available to maintain the courseware.

Ability to maintain CBT hardware and software. This indicator is identical to Item 6, "Computer System Support." A score of 3 indicates that your staff is probably capable of maintaining any type of CBT hardware and software. A score of 2 indicates weaknesses exist in some areas. A score of 0 or 1 indicates that outside assistance will probably be required to maintain the CBT hardware and software.

Some Words of Caution

This worksheet addresses your staff's depth and availability of skill in particular areas; it does not attempt to address whether you have sufficient staff on hand to do the needed work. Whether or not you have sufficient staff depends on the amount of work to be done. This will be addressed in Decisions F and G.

It would also be misleading to sum up the number of staff you have available to you (from the Availability column in Items 2-7) and conclude that you have too few or too many staff. What matters is whether or not you have the proper distribution of staff in each of the six categories to do what is needed. For producing CBT in volume, you need fairly large numbers of courseware developers and programmers, and relatively few computer system support people and managers; the number of graphics and video personnel needed will vary according to instructional requirements. For maintaining CBT instructional materials, you need courseware developers and programmers, but fewer than necessary for producing CBT. For maintaining CBT hardware and software, computer system support people are needed.

DECISION E
Type of CBT Technology Required

In Decision A, you identified those objectives which can be included in your proposed CBT system. In order to match these training requirements with hardware and software capabilities, the type of CBT technology that is required to support each objective must be identified. The worksheets in this section will set you up to do just that -- to define your specific hardware and software requirements. (Only hardware and software requirements will be addressed in this document. No specific recommendations for model, manufacturer, etc., will be made.)

The objectives identified as candidates for CBT will be categorized as requiring support for graphics, animation, audio, and video (both still and motion). In addition, the need for simulation support will be addressed. The objectives may be classified in more than one category. In other words, an objective may require graphics support and simulation support. In this case, both requirements should be noted on the Worksheet.

As you complete Worksheet E.1, concentrate on the requirements of the training system. In other words, what does the student need to see, hear, or do in order to achieve the objective? As with Decision A (what objectives to host on CBT system), the decision regarding the type of technological support will rely primarily upon the requirements of the objectives and responses you gave to questions on the Questionnaire.

Another facet of this decision will be the number of hours of instruction needing support. Once you have categorized each objective along the dimension of type of CBT support required, you should examine the number of hours of instruction that are in each category. For instance, if simulation support is needed for a small fraction of instruction, you may want to reconsider hosting this portion of the instruction on the system. This step will be explained in more detail later when you fill out Worksheet E.2.

If possible, work through this decision process with someone who has experience in selecting CBT media. If this isn't possible, the guidelines which follow will take you through the decision process and assist you in making reliable choices. If your media experience is limited, it may be advisable to read through the interpretation section before completing the Worksheet.

Worksheet E.1 Instructions

1. Using an abbreviated title or other notation in the column titled "Objectives," write each objective or group of objectives that you have selected for inclusion in the CBT system from Worksheet A. Make as many copies of Worksheet E.1 as are necessary.

2. In the column titled "Hours," write the number of instructional hours each objective or group of objectives represents.

3. Refer to questions 51, 52, and 98 on the Questionnaire. Review the objectives you listed on Worksheet E.1. Identify each objective that requires some type of simulation support. For each objective you identify, estimate the number of instructional hours requiring simulation support. Write the number (i.e., 2, 4.5, etc) in the column titled "Simulations."

   [Note: Your estimate should not exceed the total number of instructional hours for the objective. For example, if the objective you select consists of 8 instructional hours and the entire objective requires simulation support, the number you should write in the "Simulation" column for that objective will be 8 hours. This note also applies to instructions 4-7 below.]

   [It is conceivable that a single objective could require maximum support in all of the five categories listed on Worksheet E.1. For example, an 8-hour objective could require maximum support in all categories. In this instance, a total of 8 hours would be shown on the worksheet for the objective in each category (e.g., Objective Hours = 8, Simulations = 8, Graphics = 8, Animation = 8, Audio = 8, and Video = 8). However, the number you enter for the applicable categories will usually vary.]

4. Refer to questions 51, 52, 64, 65, and 66 on the Questionnaire. Review the objectives you listed on Worksheet E.1. Identify each objective that requires graphic support. For each objective you select, write your estimate of the number of instructional hours requiring graphics support in the column titled "Graphics."

5. Refer to questions 51, 52, 71, and 98 on the Questionnaire. Review the objectives you listed on Worksheet E.1. Identify each objective that requires some type of animation support. For each objective you select, write your estimate of the number of instructional hours requiring animation in the column titled "Animation."

6. Refer to questions 51, 52, and 77 on the Questionnaire. Review the objectives you listed on Worksheet E.1. Identify each objective that requires audio support. For each objective you select, write your estimate of the instructional hours requiring audio in the column titled "Audio".

7. Refer to questions 51, 52, 80, 81, 82, 88, 89 and 98 on the Questionnaire. Review the objectives you listed on Worksheet E.1. Identify each objective that requires video support. For each objective you select, write your estimate of the instructional hours requiring video in the column titled "Video."

8. Total the "hours" down each column of Worksheet(s) E.1.

Worksheet E.2 Instructions

1. Once you have totaled up all the individual Worksheets E.1 transfer the grand totals for each column to the column headed "Total Hours" on Worksheet E.2.

2. Calculate the percentage of instruction which requires each type of technology. Divide each item (1 through 5) by the figure in 6, "Total CBT Hours", and enter the result in the column Percent. There is no need to total the "Percent" column. Don't be surprised if the Percent column totals more than 100%.

Worksheet E.1

OBJECTIVES:	Hours	Simulations	Graphics	Animation	Audio	Video
Total Hours:						

DECISION E
Type of CBT Technology Required
Number of Hours

Type of CBT Technology		Total Hours	Percent
1.	Simulation Support	_____	_____
2.	Graphics Support	_____	_____
3.	Animation Support	_____	_____
4.	Audio Support	_____	_____
5.	Video Support	_____	_____
6.	Total CBT Hours	_____	_____

DECISION E
Type of CBT Technology Required

Interpretation

Worksheet E.1 provides you with a gross estimation of the type of CBT technology your system will require. As you proceed through the interpretations below, fine-tune this estimate in light of the criteria presented. After each category is addressed, review the initial classification and make any adjustments you feel are necessary. This may involve the addition or deletion of objectives. Also, an objective may rely on more than one type of CBT technology. Worksheet E.2 defines the number of instructional hours required for each type of CBT technology. This is based on the total hours from Worksheet E.1.

Simulations

Unlike graphics, animation, audio, or video support, simulations are not meaningful without some other type of support. In fact, simulations usually result from mixing technological capabilities from these other areas. However, simulations are unique because they can provide the student an opportunity to learn a task in a situation much like they would experience on the job. As a result, simulations can be powerfully effective teaching tools. They are especially valuable in situations where the costs of training a student to perform a procedure or task are high (e.g., emergency procedures, war games, and mission scenarios). Simulations can also be used to allow the student to participate in role-playing and gaming teaching sequences. Three questions on the Questionnaire (51, 52, and 98) address the issue of simulation support. If the responses to any of these questions is **Yes**, then simulation support will probably be required in your system.

Graphics

Graphic presentations can take many forms. These presentations can range from charts, diagrams and forms to complex drawings of equipment panels, human anatomy, or aerial maps. Graphics may be used in conjunction with textual material, sound presentation, still or motion video, or used as a part of a simulation. The key issue here is whether this presentation method is required for the student to master the objective. Questions 64 and 66 on the Questionnaire are the focus of this decision. If the response to either of these questions is affirmative, the objective will require some kind of graphics support. Depending on the response given to questions 51, 52, and/or 98, the role of graphics may be to support a simulation.

Animation

Animation essentially sets graphic images in motion and can be a valuable tool in instruction. For example, for an objective that requires a student to troubleshoot a hydraulic system, animation which depicts the flow of fluid through that system could be used to teach about the system and to identify points along the system which are prone to failure. Animation techniques can also be employed when teaching physical principles, such as trajectory, air flow, and lift.

This tool can also be helpful in simplifying complex theories, procedures, or decision algorithms. An affirmative response to question 71 on the Questionnaire implies that animation support is required in your system. Affirmative responses to questions 51, 52, and/or 98 imply that animation may be needed to support a simulated task. It is good to remember that animation is different from video. If the students need to see actual images in motion (like TV or movies) then video is required. If, on the other hand, the motion is more like what you would use in a cartoon, i.e., the animation of a drawing or graphic, you will need to have a CBT system capable of graphics animation.

Audio

Audio can be used to support training objectives (radio transmission skills, foreign language skills, oral communication skills) or it can be used in conjunction with graphics, animation or video presentations (descriptive narrations, instructions, motivating feedback). Implicit in question 77 on the Questionnaire is whether audio support is needed to help students accomplish any of the objectives. If audio support is indicated in the response, then your system will need this capability. Questions 51 and 52 are concerned with simulations which may also require audio support.

Video

For the purposes of this decision aid, video has two subcategories. The first contains images such as photographs, slides, filmstrips, or other high definition, realistic, static images, i.e., still video. The second category involves dynamic images, such as film sequences, i.e., full motion video.

Video can support objectives which otherwise might not be candidates for CBT. Some examples are: equipment operation (setting switches, manipulating dials, removing or replacing components, loading weapons or cargo), equipment identification (missiles, aircraft, line replaceable units, tools, instruments), identification of emergency situations and performance of emergency procedures, and so on. Virtually any objective which relies upon identification or familiarity with hardware or procedures through realistic, high quality images is a candidate for video support. Any slide, videotape, or movie, is a candidate for video support. Questions 82 and 89 ask if these types of images are required to teach any of the objectives under consideration. If these questions are answered Yes, then some type of video support is necessary. Questions 51, 52 and 98 focus on the need for realism in training. If any of these questions are answered affirmatively, video support may also be required for the simulations.

Hours

As was mentioned earlier, the number of hours of instruction that a technology supports has some bearing on whether that type of CBT should be implemented in a training system and the sophistication of the hardware and software needed to support it. This is a primary cost factor. Normally, if a technology is used for a small amount of the instruction, the cost per hour of that

instruction is greater than if the technology were used for a greater number of instructional hours. In addition, each technology is associated with varying costs in terms of hardware and software support, and development and maintenance of the instructional material. The relative costs of these technologies in terms of required hardware and software, and design and development efforts are presented in the chart that follows:

Type of CBT Technology	Hardware & Software Costs	Development Costs
Graphics Support	Low to Medium	Low to Medium
Animation Support	Low to Medium	Low to Medium
Audio Support	Medium to High	Medium to High
Video Support (static images)	Low to Medium	Low to Medium
Video Support (motion video)	High	High
Simulation Support	Low to High	Medium to High

As you can see, some technologies, such as audio, motion video, and simulation, are more expensive to implement than others. This does not mean that a technology and the objectives which rely on that technology should be eliminated from the proposed training system based on the expense or on the number of instructional hours which utilize that technology. The benefits of using the technology must also be considered, i.e., the impact on the student and his/her ability to achieve the objective. There may also be ways of minimizing the cost impact of these technologies. For example, if motion video is used for just a small portion of a course, you may just wish to have a few stations with motion video capability.

Implementing CBT Technologies

Simulations. Simulations usually utilize one or more of the other CBT technologies, and can be implemented in a variety of ways. For example, video, graphics, or animation could be used to simulate the equipment panel of a cockpit for CBT lessons on cockpit procedures. The most important thing to remember about CBT simulations is that they should replicate the most salient aspects of the object or situation being simulated. That is, a CBT simulation of a cockpit does not need to replicate every aspect of a cockpit, but it should replicate just enough to teach what is required. If the lesson objective requires the learner to interpret instruments and gauges, then the CBT simulation should (at a minimum) portray gauges in a recognizable and readable form as close to the real thing as possible, within reason. If the objective requires the learner to demonstrate walking through a flight checklist, then all the instruments that would normally

be visible in the cockpit should be visible on-screen. All the instruments need not respond in a realistic manner unless actually used. If the objective requires the learner to actually take-off and land, then a CBT simulation would probably not be sufficient to train or test the objective.

Before deciding which technologies should be employed in a simulation, you should first identify what is really being taught. For example:

> If it is important for a student to experience "the look and feel" of a piece of equipment (like the inside of a cockpit) or a situation (like dealing with a sick patient), then the simulation should utilize either animation or motion video. Of these two, animation development is usually cheaper, but video has greater fidelity.
>
> If the student is learning to identify objects or to follow steps, then graphics or still video can be used. Graphics development is marginally cheaper (depending on the sophistication of the graphics), but still video offers more life-like displays.
>
> If the goal of the training is to teach thinking or problem-solving strategies, often a primarily text-based case study is sufficient. For example, one well-known CBT lesson teaches children business strategies by letting them work through a case study in which they run a lemonade stand. The simulation allows them to perform actions such as purchase raw materials, set prices, and make allowances for rainy days. There are also science lessons which allow students to mix chemicals and perform experiments without making a mess or suffering the consequences of mistakes.

Further details about how to implement audio, video, animation, or graphics within a simulation will be covered in the following sections.

Graphics. CBT lessons almost always utilize graphics to some extent. Nearly all authoring software packages include some capability to develop graphics. In developing graphics, the main decision you must make is whether to utilize the graphics capability that comes with your authoring system, or to use a separate graphics package. The issues to be considered are compatibility, cost, capabilities, and ease-of-use.

Although it is a rare circumstance these days, some authoring packages can only use graphics created with their software. If you should happen to choose such an authoring package, you should make sure that it can produce the quality of graphics you require. Or, if you have a particular graphics package that you want to use (because you own it, or are familiar with it), you should make sure that the authoring software you select can import graphics from this package.

In general, it is usually cheaper to use the graphics capability included with the authoring software than to purchase a separate package. However, authoring software with strong graphics capabilities also tends to be expensive; conceivably, it could be more economical in some cases to purchase authoring software with fewer graphics capabilities and a separate compatible

graphics package. On the whole, the cost of the authoring system is relatively minor when all the CBT development costs are considered. Therefore, it is usually better to get the most capability you can.

Decision I will help you to identify required graphics capabilities for your CBT system. In general, graphics packages usually offer more capabilities than that which comes with authoring software. Since it is unwise to select authoring software solely on the basis of its graphics capabilities, it is a good idea to choose authoring software which is compatible with one or more other graphics packages. This will allow you more flexibility in graphics creation.

Ease-of-use matters especially if you need to create a lot of graphics, or if you need to develop fairly complex graphics (e.g., human figures, equipment panels, etc.). Again, if your authoring package is not compatible with any other graphics packages, you don't have much of an option. It is best to choose authoring software which will allow you some flexibility in the graphics packages you use.

Animation. As with graphics, animation can be achieved either by using your authoring software, or by using a separate animation package. The issues to be considered are also the same -- compatibility, cost, capability, and ease-of-use. Some graphics packages will also allow you to do animation. If you intend to use a separate graphics package, you should choose one that allows animation as well, to minimize problems with incompatibility.

Audio. There are basically three levels of audio. One is "straight" audio; i.e., audio which is not used in conjunction with video. The second level is audio used in conjunction with video, as it might be for interactive video. The third level involves voice recognition and/or intelligent voice interaction.

Straight audio can be achieved either through computer-produced sounds, or through connecting the computer to some audio-producing device, such as a tape recorder or CD player. Computer-produced sounds are easily achieved if the audio you require consists of beeps or tones. If you want other types of sounds, you will need to use other equipment. Whether you choose a tape recorder, CD player, or some other audio-producing device will depend primarily on cost, convenience, and durability. Tape recorders, for example, have a slower access time than CDs, because they cannot instantly access any point on the tape; but they are cheaper and readily available.

Audio is easily achieved when used in conjunction with video. The most commonly mentioned media for audio with video are interactive videodisc (IVD) and digital video interactive (DVI). The arguments for and against choosing one or the other will be discussed in the section on video.

Voice recognition and intelligent voice interaction technologies are still in the developmental stage, and are therefore quite expensive. You would select these technologies if

your training required some form of dialogue between the student and the instructor or if a human instructor was not available.

Video. There are a variety of technical approaches to implementing video within CBT. The two most popular are interactive videodisc (IVD) and digital video interactive (DVI). Both utilize optical media for storage (IVD normally utilizes an 11" disc; DVI normally utilizes a 4.25" disc); and both require extensive camera work initially to produce the images which are pressed on the discs. The two differ primarily in the technology they employ to process the images through the computer. The technology DVI employs allows more flexibility in terms of micro-level manipulations of video images; in other words, it's easier to develop a picture of a dial turning or an indicator moving using DVI than IVD. But DVI is also still in development, and is at present more expensive than IVD. This may change soon, however.

Conclusion

Later decisions (specifically, Decisions H-L) will help you to describe what capabilities your CBT system will need to have in the areas of text, graphics, animation, audio, and video. After completing these sections, you should be able to match your required capabilities to the appropriate methods for implementing these technologies.

DECISION F
In-house CBT Development

The decision to develop computer-based instruction with in-house resources has certain cost implications. Necessary facilities, equipment, and personnel must be available. Facilities and equipment will be addressed elsewhere in this guide; only the personnel issue will be considered at this point. The capability of in-house staff to perform the needed developmental work should be explored very early in the decision making process since it is an essential element of effective planning. In assessing in-house capability, you must consider the staff's CBT instructional development training and experience. Some objective indicators such as length and type of development training and first-hand experience may provide some assistance in making this assessment; however, the final determination will still be subjective.

Worksheet F asks you to assess the in-house staff's overall capability to perform, then, with the aid of a simple formula, determine approximately how many people (i.e., man-years of performance) are required. With this knowledge, and knowing the number and availability of qualified staff members, you can better determine whether it is feasible to conduct CBT instructional development using in-house resources.

Complete Worksheet F according to the instructions provided below. Upon completion, you should consult the section titled **Interpretation** for a more detailed explanation of each item and the responses.

Instructions

1. Refer to Worksheet D, Item 8 and the rating you previously gave your staff for in-house capability to perform CBT instructional development. Select the line and rating on Worksheet F that matches the rating you gave on Worksheet D, circle 1, 2 or 3. Refer to Worksheet E.1 for the total number of instructional hours requiring CBT development. Write this total in the appropriate space provided under Column A on Worksheet F next to the number circled. Multiply this figure times the number provided (e.g., .12, .25, or .35) and write the result in the appropriate space under Column B. The final figure represents the approximate number of personnel needed to develop the total amount of CBT instruction in-house during a one year period. If the development period will be longer than one year, adjust the figure accordingly.

2. Determine the date that your organization requires the course to be on-line training students. Enter this date in Worksheet F, Item 2.

3. Determine the date that your organization can begin CBT course development. (Remember you must ensure that the required personnel are available, and that courseware authoring software and computer hardware needed for development will be on hand at this time.) Enter this date in Worksheet F, Item 3.

4. Calculate the time available to develop. Use the date in Item 3 as a beginning and the date in Item 2 as an end. Enter this time in Item 4. Circle "Months" if this time is expressed in months, or "Years" of it is expressed in years.

5. Take the number of man-years required which you calculated in Item 1 and enter that number here in the appropriate blank. If not already expressed in "years," convert the time available to develop (Item 4) to years (i.e., divide the number of months by 12). Enter the number in the blank provided. Divide the number of man-years required by the time available. The result is the number of full-time staff required to develop the CBT within your given time limits.

6. Write the staff required in the blank provided. Refer to Decision D, Item 8, "Availability." Write in the number of staff available from that worksheet. Subtract the number of staff available from the staff required.

    a) If the result is 0 or a negative number, then you are probably staffed sufficiently to develop CBT in house.

    b) If the result is 1 or more, you will need this many additional full-time personnel to develop the CBT in house.

DECISION F
In-house CBT Development

1. If the "Capability" rating from Worksheet D, Item 8 is:

	Col. A.			Col. B.
"1", then multiply	_____	x .35	=	_____
"2", then multiply	_____	x .25	=	_____
"3", then multiply	_____	x .12	=	_____

2. Date Course On-line: _____

3. Begin Development Date: _____

4. Time to Develop: _____ Months/Years

5. _____ (# Man-years Required) divided by _____ (Time To Develop (Years)) = _____ (Staff Required)

6. _____ (Staff Required) minus _____ (Staff Available) = _____ (Additional Staff Needed)

DECISION F
In-house CBT Development

Interpretation

Worksheet F is designed to assist you in deciding whether or not to perform CBT instructional development in-house. From the information assembled through the worksheet, you should be able to gain a general estimate of your organization's capability to perform the required work. The factors used in the worksheet and the interpretation follow:

Man-year Requirements and Qualified Staff

The number of known instructional hours requiring CBT development, alone, does not yield sufficient information to make a decision for or against in-house support. An estimate of the staff's capability to perform the work is essential. An experienced staff can be expected to perform more efficiently than one that has little or no experience. For this reason, experience factors are considered; they are based on reasonable estimates. Depending upon the experience of the staff, the number of CBT development hours required to produce one hour of instruction can range from as little as 200 or less (highly experienced) to as much as 600 or more (much less experienced). If the development includes interactive technologies such as IVD, CD ROM, or DVI, the figure could be as high as 1000+ hours. Also to be considered is the complexity of the subject matter. If the subject matter is such that an extraordinary amount of information or supporting graphic material is required, the ratio may be greater.

While fulltime staff members may be compensated for approximately 2,080 hours per year, you should not overlook the fact that their average fulltime availability to perform direct work is somewhere around 1800 hours or less. We have used 1800 in our calculations. This time difference is primarily attributable to vacation, sick leave, training, administration, other duties, etc. Dividing the number of instructional hours per year by the number of available man-years for one person will provide a good estimate of the number of man-years required to perform the work for that period of time. The resultant number of man-years may only be viewed as equaling the number of required staff members if each staff member's full performance is devoted to the work for the entire period. In this regard, dividing the total required man-years by the number of available qualified staff members provides an estimate of the length of time required to perform the work. If the resultant length of time is unacceptable, it may be more reasonable to seek courseware development support through some other means, such as contract. In this instance, the entire development effort could be contracted out, or the development effort could be divided and specific parts developed separately by in-house and contractor staff according to capability.

If you have the capability to do less than half the work in the time allotted for the interactive courseware (ICW) to be in place, we strongly recommend you explore the contracting option. This is not to say that contracting should not be considered even if your organization can

accomplish more than half the work. Quality, accountability, and other issues may need to be considered. Using in-house assets may provide a good way of reducing the cost of CBT development; however, timeliness and consistency of quality can suffer due to turnover of personnel and other problems associated with developing CBT in-house.

DECISION G
In-house Instructional Maintenance Support

Like the decision to develop CBT courseware with in-house resources, the decision to maintain/modify CBT courseware has certain cost implications. However, the decision must, first, be based on capability to perform the work. In assessing in-house capability, you must consider your staff's CBT courseware development/maintenance training and experience. While there may exist some objective indicators of the staff's expertise, the final decision must be based on your subjective assessment.

This worksheet asks you to assess the in-house staff's overall capability to perform, then, with the aid of a simple formula, determine approximately how many man-years of performance is required. With this knowledge, and knowing the number and availability of qualified staff members, you can better determine whether it is feasible to provide CBT courseware maintenance or revisions support using in-house resources.

Complete Worksheet G according to the instructions provided below. Upon completion, you should consult the **Interpretation** section for a more detailed explanation of each item and your responses.

Instructions

1. In the appropriate space provided on the worksheet, list your estimated average number of courseware revision events per year. (Refer to question 2 of the Questionnaire, Part I for this information.) Next, provide an estimated average number of instructional hours per event requiring courseware revision. (Refer to question 3 of the Questionnaire, Part I for this amount.) List this amount on the line provided. Multiply the average number of revision events per year by the estimated average number of instructional hours per event requiring courseware revision. Enter the result on the line titled "Total hours." These are the estimated number of instructional hours per year requiring some level of instructional materials maintenance.

2. Refer to Worksheet D, Item 9 and the rating you previously gave for in-house staff capability to perform CBT instructional materials maintenance/modification. Select the line and rating on Worksheet G that matches the rating you gave on Worksheet D. Circle 1, 2 or 3. Refer to the "Total hours" figure you calculated above. Write this total in the appropriate space provided under Column A on Worksheet G. Multiply this figure times the number provided (e.g., .12, .25, or.35) and write the answer in the appropriate space under Column B. The final answer represents the number of man-years needed to maintain the total amount of instructional materials per year requiring some level of maintenance/modification.

3. Take the number of man-years you calculated in Column B on Worksheet G, and write it in the space labelled "# Man-years." Refer to Decision D, Item 9, "Availability."

Write the number of staff members available to perform in-house instructional materials revision in the space labelled "# Staff." Subtract the number of staff available to do courseware revision from the number of man-years required. If the result is 0 or a negative number, your organization has sufficient staff to perform in-house CBT courseware maintenance. If the result is 1 or more, this is the number of additional personnel that you will need to perform courseware maintenance.

DECISION G
In-house Instructional Maintenance

1. Estimated average number of events per year = _____

   Estimated average number of hours per event = x_____

   Total hours = _____

2. If the "Capability" rating from Worksheet D, Item 9 is:

	Col. A		Col. B
"1", then multiply	_____	x .35 =	_____
"2", then multiply	_____	x .25 =	_____
"3", then multiply	_____	x .12 =	_____

3.

_____	minus	_____	=	_____
# Man-years		# Staff		Additional Staff Needed

DECISION G
In-house Instructional Maintenance Support

Interpretation

Worksheet G is designed to assist you in deciding whether or not your organization will be able to provide instructional maintenance support in-house. From the information assembled on Worksheet G, you should be able to gain a general estimate of your organization's ability to perform the required work. The factors used in the worksheet and the interpretation follow:

Instructional Maintenance Hours

Aside from initial courseware development, there is a continuing need to update and maintain interactive courseware (ICW) materials. While it is conceivable that the latter could be accomplished by the same personnel that initially developed the courseware, they may not be available to perform ICW revisions. Additionally, the amount of instruction actually requiring maintenance and the frequency of such events must be considered in planning the number of personnel needed to meet the courseware maintenance requirements. We recognize that it normally takes fewer personnel to maintain ICW once it has been implemented than it does to develop it initially. For this reason, if you can perform courseware development in-house to implement a course, you will probably be able to maintain this courseware as well. It is much more critical to determine if your organization can maintain ICW which has been developed for it by some other organization. Just as with the process of determining whether your organization can develop the ICW in-house, you must also determine the volume (i.e., the number of hours) of ICW which will be affected by revision annually. Multiplying the known or estimated number of maintenance events per year times the number of hours per event yields the total number of instructional hours per year requiring some level of courseware maintenance. This provides a gross measure of the volume of ICW which will need revision annually. Generally, an estimate of 5 percent is normal.

Man-year Requirements

The man-year requirements comments provided for Worksheet F as they relate to the initial development of CBT also apply to in-house instructional maintenance support. While it is feasible to supplement an in-house maintenance effort with contractor assistance, this option is rarely elected due to the potentially low volume of work resulting from such a shared arrangement. What you may wish to do, if you are contemplating contracting the CBT courseware development, is to have the contractor train your staff to maintain the courseware. This option allows you to get the staff involved with the CBT courseware prior to its implementation, thus enhancing the potential for CBT acceptance.

DECISION H
Text Support Requirements

Most computer systems offer support for presentation of textual material. If you are going to acquire a CBT system, you will have to prepare specifications which describe in detail what you want your system to do. However, before developing a CBT system specification, you should identify whether any special textual requirements are needed. This will help ensure that the hardware and software you acquire will be able to support this requirement.

Instructions

1. Refer to question 62 on the Questionnaire. Check the boxes on Worksheet H which correspond to the choices selected. These will identify required textual presentation features. You will use these in evaluating authoring software for acceptability. If an authoring system does not have the capability to address one/some of the requirements you listed, it should receive a lower ranking than ones which do. Critical requirements which cannot be met may be reason for eliminating an authoring system from consideration.

2. Refer to question 63 on the Questionnaire. Check the boxes on Worksheet H which correspond to the choices selected. This will identify required special character sets. Again, you will use these in evaluating authoring software for acceptability. If authoring software does not have the capability to address one/some of the requirements you listed, it should receive a lower ranking than ones which do. Critical requirements which cannot be met may be reason for eliminating authoring software from consideration.

DECISION H
Text Support Requirements

1. Required Textual Presentation Features [62]

   a. Different type styles (fonts) . . . . . [ ]
   b. Different type sizes . . . . . [ ]
   c. Underlining . . . . . [ ]
   d. Bolding (highlighting) . . . . . [ ]
   e. Blinking . . . . . [ ]
   f. Different colors . . . . . [ ]
   g. Other (specify) _____

2. Required Special Character Sets [63]

   a. Mathematical symbols . . . . . [ ]
   b. Schematic symbols . . . . . [ ]
   c. Engineering character set . . . . . [ ]
   d. Scientific character set . . . . . [ ]
   e. Programming language character set . . . . . [ ]
   f. Foreign language character set . . . . . [ ]
      Specify language _____
   g. Other (specify) _____

DECISION H
Text Support Requirements

Interpretation

Worksheet H is designed to assist you in defining some of your CBT system requirements with regard to text. Use the data generated in completing this worksheet as a tool for evaluating commercial CBT authoring software. Each authoring package evaluated should be compared to the listed requirements. If the authoring system does not provide the required capability, it should be considered less capable than those which do. Remember, you are not trying to determine the "best" authoring system available on the market; rather, you are trying to determine which authoring software packages most closely match your requirements.

Required Textual Presentation Features

Most authoring systems have the capability to meet the various textual presentation features which you have identified. However, you should ensure that these features are built into your CBT authoring system evaluation criteria so that a needed feature is not left out. A good rule-of-thumb to remember is that if you presently use these features in your printed materials, it will probably be used in the CBT courseware (plus additional features).

Required Special Character Sets

Ordinarily, whenever special character sets are needed in print materials to support instruction, they will also be needed for the CBT lessons for the same training requirements. There are several authoring packages available on the market which offer special character sets. In addition, some commercial vendors of authoring software packages may be willing to tailor their system to meet your special needs. This will probably be at a cost, but you should evaluate the cost in terms of the time saved in developing lessons and maintaining those lessons using the system without the special character sets. Special character sets have a very specific application, so if you don't need them, don't include them in the requirements by which you will evaluate CBT systems.

All of the information which you have recorded here will be used to evaluate the hardware and software which will be used in your CBT system. Although you may have identified a specific text support requirement and a software package which can provide it, don't forget that the hardware which you acquire must also be able to support the requirements. Some typical questions to be answered are: Does the software operate on the hardware? Are any special monitors, graphic boards, etc., required to enable the software to play? Does the software cause any undesirable problems when used in combination with the hardware, e.g., screen flicker?, etc. This information needs to be incorporated into the specification which you will develop for your system. We recognize that many organizations will be required to purchase hardware from existing government contracts. That's fine as long as the hardware which is available matches

your training requirements. If it doesn't, the specification needed to purchase the proper equipment needs to incorporate this information.

DECISION I
Graphics Support Requirements

If any of the objectives listed on Worksheet E.1 will require the use of graphics, you should complete this section. If not, please write "Not Applicable" across the top of the Decision I worksheet, and continue to Decision J at this time.

As mentioned in Decision E, graphics vary in their degree of complexity and realism. These differences require various levels of graphic support and capabilities at the hardware and software level. While most authoring software packages come equipped with some graphics capabilities, these can differ widely. There are instances where an additional graphics software package is necessary to supplement the capabilities provided with the authoring software. To ensure that your training requirements are met, a description of the required capabilities should be included in your system specification. This worksheet will assist you in pulling together this information. Remember that you will use the information collected here together with other information which you provided in other sections of this document to distinguish among various candidate CBT systems and to select the one which best suits your requirements

As you complete this worksheet, carefully consider the requirements of each of the objectives you have slated for graphics development (Worksheet E.1).

Instructions

1. Refer to questions 65 and 66 on the questionnaire. If options **c, d, e, f, g** or **h** were selected on question 65 and you answered **Yes** to question 66, then you should indicate the need for "High" graphics support by placing a check in the corresponding box by Item 1.

   If options **c, d, e, f, g** or **h** were selected on question 65 and you answered **No** to question 66, then you should indicate the need for "Moderate" graphics support by placing a check in that box.

   If objectives **a** or **b** were selected on question 65, then you should indicate the need for "Low" graphics support by placing a check in that box.

   If option **i** was selected on question 65, then indicate that "No" graphics support is required by placing a check in that column of Worksheet I.

2. Refer to question 67 on the Questionnaire. If the answer to this question is **Yes**, mark the box "Color support required" by Item 2.

3. Refer to questions 68 and 69 on the Questionnaire. If the answers to both questions 68 and 69 are **Yes**, mark the box "Color printing."

If question 68 is answered **Yes** and question 69 is answered **No** check the box corresponding to "Printing" on Worksheet I.

If question 68 has been answered **No**, check the box corresponding to "No graphics printing required."

4. Refer to question 70 on the Questionnaire. If the answer to this question is **a**, you should consider the impact such changes will have on any courseware development and maintenance. Make adjustments to this worksheet, if necessary. If these changes will impact training requirements, you may also wish to make changes to the Decision E worksheets.

DECISION I
Graphics Support Requirements

1. Level of graphics support required [65, 66]

   High . . . . . [ ]

   Moderate . . . . . [ ]

   Low . . . . . [ ]

2. Color support required [67] . . . . . [ ]

3. Level of printing support required [68, 69]

   Color printing . . . . . [ ]

   Printing . . . . . [ ]

   No graphics printing required . . . . . [ ]

DECISION I
Graphics Support Requirements

Interpretation

Worksheet I data can be used to evaluate CBT authoring systems, if you intend to develop lessons in-house, or to develop a system specification if you intend to contract the effort out to a CBT developer. When preparing a CBT system specification, you must define your graphics support requirements carefully to ensure these needs are met. Generally, if a "High" degree of support is required, some type of auxiliary graphics support software package may be required. Graphics software programs available as stand-alone packages are typically more powerful and versatile than those provided with authoring software. However, if you decide to purchase a stand-alone graphics package, it must be compatible with the authoring package you select. When you evaluate authoring software, you should determine what graphics packages are supported.

Some issues to consider when selecting graphics software packages (whether built-in to authoring software or as a separate package) are: 1) the ease of development and editing (e.g., pull-down menus or icons to select options; user friendliness); 2) development and editing capabilities (pixel-level development and editing is required for detailed images); 3) types of input devices that can be used (e.g., keyboard, mouse, bitpad, scanner); 4) availability of on-line help or a tutorial; and 5) vendor support (telephone support). These factors should also be used in assessing CBT authoring packages for selection. This is highly critical if you are going to develop the CBT lessons in-house. If you are going to rely on contractor support, it is less important, since most contractors will have experience in these areas.

Another factor is cost. "Moderate" capability graphics packages are usually less expensive in terms of design and development time and in terms of hardware and software requirements than "high" level graphics, which are customarily more expensive. However, if the software is truly user-friendly and the package is compatible with a variety of input devices, the development time for high-definition, realistic graphics can be kept to a minimum, thereby reducing development costs.

When making the determination as to which graphics software package offers the best support for your training needs, consult with the developers of the software and, if possible, some of their customers. (This is true for all software, not only graphics packages.) Cite specific examples of what you need to be done so the vendor can evaluate your needs and provide you with an assessment of how the software can accomplish them.

The printing of graphics is sometimes necessary to support training. The cost of printing graphics and the ability of some authoring software to print graphics which are created by the software can vary quite a bit. You should resist the temptation to acquire the capability to print graphics unless it can be done easily by the authoring software, and the graphics printer is readily

available. Color graphics printing is quite expensive and may require special software to enable you to do it. You will also require a color printer/plotter which can be very expensive. Select these options carefully.

DECISION J
Animation Support Requirements

If any of the objectives listed in Worksheet E.1 will require animation support, you should complete Decision J. However, if your training requirements will not rely upon animation, please write "Not Applicable" across the top of the Decision J worksheet, and continue to Decision K. Remember that there is a difference between the animation of graphics images and full motion video. Put simply, animation graphics is similar to what we commonly think of as "cartoons", while full motion video is like a motion picture. You must determine which of these is required for your training objectives.

As with graphics, animation sequences can differ in complexity and image fidelity. Some authoring software packages provide animation capability, as do some graphics packages. There are also separate animation software packages which can be purchased. The decision as to which type of package is right for your system can be important. A description of your animation requirements should be included in your CBT system specification. The worksheet provided in this section will help outline the animation needs of your CBT system. Remember there is a difference between animation of a CBT graphic and full motion video. Full motion video should be used if a high degree of realism in the picture and motion sequences is required. Otherwise you may be able to use animated graphics.

As you complete this portion of the decision aid, bear in mind the requirements you identified in Decision E. Some of your animation requirements may spring from the need for simulations. These should be considered when completing this worksheet.

Instructions

Complete Items 1-4 on Worksheet J by transferring your responses from the Questionnaire. The corresponding question number is listed in brackets after each item. If an item of the worksheet refers to a question which was not answered on the Questionnaire, write NA (not applicable) beside the item and move on to the next item.

Refer to question 76 on the Questionnaire. If the answer to this question is **Yes**, consider the implications of these changes for the animation requirements which you have just defined. Make any adjustments necessary. If any of these changes will affect training requirements, you may also wish to make changes to the Decision E worksheets.

DECISION J
Animation Support Requirements

1. Level of complexity of animation required [72]

   Complex (e.g., equipment panels, human figures, terrain maps) . . . . . [ ]

   Simple (e.g., line drawings, stick figures, geometric shapes) . . . . . [ ]

2. Simultaneous animation of several objects required [73] . . . . . [ ]

3. Importance of smooth motion in animation [74]

   Very important . . . . . [ ]

   Moderate importance . . . . . [ ]

4. Color support required [75] . . . . . [ ]

DECISION J
Animation Support Requirements

Interpretation

Animation requirements should be defined carefully when completing a specification for your CBT requirements. If the animation requirements are "moderate" in terms of image complexity and movement, the capabilities offered with some authoring packages may be sufficient. However, if your animation requirements are "high" in that high definition images and more complex movements are necessary, you may need to consider either graphics packages with animation abilities or animation development software. Use this requirement to assess the capability of various authoring packages. If possible, have the vendor demonstrate how he would animate one of your more difficult examples. If the authoring software packages which you review are not capable of handling your requirements, you may need to get them to recommend specific animation packages which are compatible with the authoring software.

Not only are options available to you in the form of software support, but other considerations are important as well. If separate animation and/or graphics packages are purchased, compatibility between these packages and the authoring software is imperative. Other factors to consider include: ease of development and editing (pull-down or pop-up menus or icons to make operation selections); development and editing capabilities (pixel-level development and editing is required for detailed images); computer memory requirements to develop and deliver animated sequences; effect of computer processing speed on quality of animation presentation (too slow or too fast); types of input devices that can be used (keyboard, mouse, bitpad, scanner); availability of on-line help or a tutorial; and vendor support (telephone support). You should consider many of the same factors as you did in evaluating graphics packages.

With regard to cost, animation design and development costs are relatively moderate. Development time is heavily dependent upon the animation software being used. If a stand-alone animation software package is purchased, your system costs naturally increase; however, depending upon the degree of sophistication your training requirements dictate, the increase may be nominal in comparison to total system cost. This option may be particularly appealing if the separate package can reduce development time.

When investigating your options with regard to animation support, provide the vendors with specific examples of the types of image sequences you want to run. If possible, speak with some users of these various packages. They can be a valuable source of information, particularly with regard to the ease of use and quality of presentation.

DECISION K
Audio Support Requirements

If any of the objectives listed in Worksheet E.1 will require audio support, you should complete this section. If your training requirements will not rely upon this medium, please write "Not Applicable" across the top of the Decision K worksheet and continue to Decision L.

Because the extent of audio support requirements vary, definition of your system requirements is essential. One issue to be addressed deals with simultaneous presentation of audio material and visual images (text, graphics, etc.). A second issue is the level of audio interactivity required for the student to meet the objectives. In other words, will the student be required to listen only (with or without visual presentation), listen and respond orally with the response verified as correct or incorrect, or will the student need to carry on a conversation with the computer (intelligent voice interaction). The Decision K worksheet will help you identify the nature of your requirements.

As you complete this portion of the decision aid, refer to the requirements you identified in Decision E. Your audio requirements may be coupled with a need for simulations and/or video. This should be considered when completing the worksheet.

Instructions

1. Refer to question 77 on the Questionnaire. If options **a or b** have been selected, mark the block corresponding to "Presentation only" by Item 1 on Worksheet K.

   If option **c** has been selected, check the block "Presentation and interpretation."

   If option **d** has been selected, check the block "Interaction."

2. Refer to question 78 on the Questionnaire. If the audio is supplemented by some sort of verbal or written instruction, graphics display, or animated sequence, check the corresponding boxes by Item 2 on Worksheet K.

   Refer to question 83 on the Questionnaire. If options **b or c** are selected, place a check in the block by "Still Video" under Item 1 on Worksheet K.

   Refer to question 90 on the Questionnaire. If options **b or c** are selected, mark the box corresponding to "Motion Video" by Item 1 on Worksheet K.

3. Refer to questions 79 and 93 on the Questionnaire. If the answer to either of these questions is **Yes**, consider the implications of these changes for the audio support requirements you have defined. Make any adjustments to the worksheet you feel are

necessary. If these changes will impact training requirements, you may also wish to make changes to the Decision E Worksheets.

DECISION K
Audio Support Requirements

1. Type of audio support required [77]

Presentation only . . . . . [ ]
(Oral narration, sound or language recognition)

Presentation and interpretation . . . . . [ ]
(Oral communication)

Interaction . . . . . [ ]
(Intelligent voice interaction)

2. Simultaneous presentation with:

Textual material [78] . . . . . [ ]

Graphics [78] . . . . . [ ]

Animation [78] . . . . . [ ]

Still video [83] . . . . . [ ]

Motion video [90] . . . . . [ ]

DECISION K
Audio Support Requirements

Interpretation

This worksheet should serve as the basis for the audio support capabilities portion of your system specification. Your needs will influence authoring software selection and hardware requirements (Decision S). You should use the data gathered in this section to evaluate authoring packages and/or to build a CBT system specification. Each authoring package which you are considering should be assessed against your requirements. If an authoring software package is incapable of meeting your requirements, it should be considered for elimination. If you are going to have a contractor develop your CBT system, you should build these audio support requirements into your system specification. Remember, the more detail you can provide the contractor, the more accurate his price will be.

The costs associated with the three types of audio interactivity obviously vary. "Intelligent voice interaction" is the most expensive in terms of development, production and delivery. It is also still in the development stage at the writing of this document. Therefore, you may not be able to find an authoring package which offers it as an option. You will probably need a very sophisticated program to be written for your voice requirements. This is followed by "Presentation and interpretation," which is less expensive. "Presentation only" audio support is the least expensive of the three types discussed here. Audio is frequently handled these days by the audio tracks of an interactive video disc or by digitizing the audio. Neither of these options is cheap. Examine your objectives closely to determine whether CBT with audio is worth the investment. If it is, be sure to list all of the details of your requirements in the specification, including the number of minutes/hours of audio, the kind(s) required, and any other information which you can provide.

DECISION L
Video Support Requirements

If any of the objectives listed in Worksheet E.1 will require video support, you should complete Decision L. If the objectives will not rely upon this medium, please write "Not Applicable" across the top of the Decision L Worksheet and continue to Decision M.

As described earlier in Decision E, two types of video are distinguishable: still images and full motion video. Still images are high definition, high fidelity (or very realistic) reproductions, e.g., photographs or 35mm slides of the actual equipment or environment. (High resolution, life-like graphic images are not included in this category; they are considered to be graphics, not video.) Motion video, on the other hand, is made up of still images set in motion; essentially, it is the same as a motion picture or film. When combined with textual material, graphics, animation, audio, and/or video stills, you have interactive video (IVD) or digital video interactive (DVI). The identification of your system's video requirements is important because the software and hardware support required for these types of video differ. The worksheet provided here will help you categorize the requirements for each type of video.

As you complete Decision L, refer to the requirements you identified in Decision E.

Instructions

1. Refer to questions 80 and 81 on the Questionnaire. If the answer to both of these questions is **Yes**, indicate the need for still video support by placing a check mark in the box corresponding to "Still video support requirements" by Item 1 on Worksheet L. If the answer is **No**, proceed to the instructions for Item 3.

   A. Refer to question 82 on the Questionnaire. If the answer to this question is **Yes**, check the box corresponding to "Color support" on the worksheet.

   B. Refer to question 83 on the Questionnaire. If options **a or c** are selected, place a check in the box corresponding to "Textual material" on the worksheet. If options **b or c** are selected, check the block corresponding to "Audio" on the worksheet.

      Refer to question 84 on the Questionnaire. If options **a or c** are selected, mark the box corresponding to "Graphics" on the worksheet. If options **b or c** are selected, put a check in the block coinciding to "Animation" on the worksheet.

2. Refer to questions 88 and 89 on the Questionnaire. If the answer to both of these questions is **Yes**, indicate the requirement for motion video support by placing a check mark in the box corresponding to "Motion video support." If the answer to these questions is **No**, skip the rest of this item.

   A. Refer to question 92 on the Questionnaire. If the answer to this question is **Yes**, identify the color support requirements by placing a check mark in the block coinciding with "Color support."

   B. Refer to question 90 on the Questionnaire. If options **a or c** are selected, place a check in the box corresponding to "Textual material" on the worksheet. If options **b or c** are selected, check the block corresponding to "Audio" on the worksheet.

      Refer to question 91 on the Questionnaire. If options **a or c** are selected, mark the box corresponding to "Graphics" on the worksheet. If options **b or c** are selected, put a check in the block coinciding to "Animation" on the worksheet

3. Refer to questions 85 and 86 on the Questionnaire. If the answer to question 85 is yes, indicate the need for printer support by marking the block associated with "Printer support" on the worksheet. If the answer to question 86 is **Yes**, indicate the need for color printing by marking that block on Worksheet L.

4. Refer to questions 87 and 93 on the Questionnaire. If the answer to either of these questions is **Yes**, consider the implications the changes may have for the video support requirements you have defined. Make any adjustments to the worksheet you feel are necessary. You should go back to the Decision E Worksheets and change/revise those objectives which you are planning to be different when CBT is implemented.

DECISION L
Video Support Requirements

1. Still video support required [80, 81] . . . . . [ ]

   Still video requirements:

   a. Color support [82] . . . . . [ ]

   b. Simultaneous presentation with:

      Text [83] . . . . . [ ]

      Audio [83] . . . . . [ ]

      Graphics [84] . . . . . [ ]

      Animation [84] . . . . . [ ]

2. Motion video support required [88, 89] . . . . . [ ]

   Motion video requirements:

   a. High resolution support [89] . . . . . [ ]

   b. Color support [92] . . . . . [ ]

   c. Simultaneous presentation with:

      Textual material [90] . . . . . [ ]

      Audio [90] . . . . . [ ]

      Graphics [91] . . . . . [ ]

      Animation [91] . . . . . [ ]

3. Level of printing support required [85, 86] . . . . . [ ]

   Color printing . . . . . [ ]

   Printing . . . . . [ ]

   No video printing support required . . . . . [ ]

DECISION L
Video Support Requirements

Interpretation

You will use the data gathered here for evaluating authoring software capabilities and to develop a system specification to acquire the hardware and software for your CBT system. If you are going to develop the courseware in-house, you should evaluate each authoring package being considered using these requirements. If an authoring software package cannot meet your requirements, it should be considered for elimination. If your courseware is going to be contractor-developed, these requirements should be contained in the system specification which you will provide to the contractor. From the completed worksheet, you can characterize the type of video support your system will require. In addition, you will also be able to describe what type of simultaneous presentation capabilities are necessary.

Video support as defined here can be quite expensive. The development and production costs, as well as the hardware required for delivery can be high. In addition, the cost of maintaining the courseware is higher for this type of presentation.

Of the two types, still video and motion video, still video is usually less expensive. Some authoring and graphics packages will support digitized still photographs stored in the computer, thus lessening the likelihood of needing VCR or laser disc players. (However, this storage and retrieval method can increase the need for processing speed and storage capacity.) Still video presentations are also more easily maintained since they typically don't require a production and recording crew to shoot new sequences of film.

DECISION M
Protection or Access Control Requirements

Most organizations desire some type of access control to their CBT systems. At a minimum, it is desirable to prevent users from accidentally (or intentionally) deleting or changing information on the system. In some cases, there may also be specific security requirements (e.g., TEMPEST) that must be met. The purpose of this section is to help you to plan for the types of access control you will require on your system, if any, and to suggest some alternatives for achieving them.

Basically, there are three areas a computer user could potentially have access to in a CBT system -- lessons, records, and capabilities. ("Capabilities" refers to the ability to create, change, or delete material from the system.) Also, there are basically four types of users -- students, instructors, CBT developers and system administrators. In deciding what types of access control your system will require, it may help to consider the types of users you have and the types of things each should have access to.

Worksheet M is a little different from others you've encountered up to this point in that it does not rely upon the Questionnaire. It is assumed that you will want some degree of protection for your CBT system.

Instructions

This worksheet lists the four potential types of CBT system users across the horizontal axis; and levels of access down the vertical axis. The instructions below describe the level of access which is typically given to each of the three types of users. As you read the general guidance provided below, please mark the boxes corresponding to the various levels of access your organization requires each type of user to have.

1. Generally, students should only be allowed to take lessons in their assigned course(s) and to review their own records. They should also be allowed access to testing only at specified times. They probably should not be allowed access to any capabilities, unless you are willing to accept the consequences. However, you may wish to expand their access in some cases as, for example, to give them access to word processing software on the same machine. Sometimes you may wish to restrict this access as, for example, by forcing them to take lessons in a particular order, or by blocking their access to certain lessons.

2. Instructors should, at a minimum, have access to the lessons and records of their students, and should have the capability to make changes to these records, but you may not want to give them unrestricted access to the entire CBT system. For example, in cases where instructors are not proficient computer users, you may want to "accident-proof" the system by limiting what they are able to do.

3. CBT developers should be able to create, change, and view lessons. They may also require access to various types of software tools, such as graphics packages. They do not usually need to have access to student records.

4. System administrators must have complete access to the system. The system administrator is an important individual in any computerized organization. The system administrator controls the system by granting access to the system, determining the levels of access of individual users (either students, instructors, or other staff), maintaining configuration control of the system, and ensuring that the system is able to meet its operating schedule commitments.

DECISION M
Protection or Access Control Features

	Student	Instructor	CBT Developer	System Admin.
Access to lessons limited				
Access to any lesson				
Ability to change lesson material				
Access to student records limited				
Access to any student record				
Ability to change some student record				
Ability to change any student records				
Access to some non-CBT related computer capabilities				
Access to any non-CBT related computer capabilities				

DECISION M
Protection or Access Control Features

Interpretation

Worksheet M was intended to help you to begin to specify your protection or access control needs. You may want to further develop your CBT system specification by adding categories of personnel, or by refining the levels of access. Knowing the precise level of protection or access control you need will help you to be a smarter buyer in terms of getting what you need from your CBT system.

Access control is not exclusively a function of the type of CBT system you select; it can also be achieved by non-technical means. Basically, access control can be achieved by external means, internal means, or a combination of the two. External methods may include restricting access to the CBT facilities, having someone always in the room, locking, or never loading certain files on the system (e.g., not putting authoring software files on a system). With these controls in place, no amount of computer hacking will increase user access. Moreover, these measures are often inexpensive and easily implemented. Internal methods can be implemented via software, and generally employ password controls, write-protection, or concealment to restrict users' access to the system. Internal methods for access control are never fully hacker-proof, but can be very effective when used in combination with external methods.

DECISION N
CMI Support Requirements

The purpose of this section is to help you to determine what Computer-Managed Instruction (CMI) capabilities your system will require -- that is, all the functions which the CBT system must perform to "manage" the course. This includes scheduling students for lessons, keeping track of their progress, administering and scoring tests, and so on. You will specify requirements for your CBT system with regard to record keeping, report generation, maintenance of data compiled off-site, and access to records.

Often we don't recognize the need for CMI capabilities until it is too late, i.e., until after we have already chosen a CBT authoring system based on its more "glamorous" graphics capabilities. Computer-Managed Instruction can be a very powerful training "tool," if used properly. The time which an instructor spends grading tests, calculating class averages, maintaining paper-based student records, and other tasks of this type can be reduced or eliminated by a good CMI package. In the same vein, performing test item analysis, computing the effectiveness of various lessons, teaching multiple classes of students over several months/years can also be assisted or fully automated by some CMI components of authoring systems.

When figuring out your CMI requirements you will consult the Questionnaire for information on what your current student management requirements are. Don't be limited by what you are doing now. Remember that the introduction of CBT is supposed to **improve** your current operations, not just automate the presentation of instruction. The proper use of CMI can simplify the tasks which instructors must perform, freeing them up to provide additional support to weaker students. The right combination of CMI capabilities can also improve the quality of the courseware by monitoring the effectiveness of individual lessons over a long period.

If you need any of the CMI functions indicated, check them off on Worksheet N. This information should be used to evaluate authoring systems and to develop a CBT system specification. You should assess each CBT authoring system's capability to meet your requirements. If an authoring system does not meet your requirements, it should be considered for elimination. If you intend to have your CBT system developed by a contractor, this information should be used to develop the system specification to be used to acquire the CBT system.

Instructions

Complete Items 1-9 on Worksheet N by referring to your responses on the Questionnaire. Just mark the appropriate block on the worksheet for each item you checked on the Questionnaire. If an item on the worksheet refers to a question which was not answered on the Questionnaire, write NA (not applicable) beside the item and move on to the next item.

DECISION N
CMI Support Requirements

1. Individual student record requirements [99]

   a. Lesson grades . . . . . [ ]
   b. Block grades . . . . . [ ]
   c. Course grades . . . . . [ ]
   d. Previous course grades . . . . . [ ]
   e. Current assignments . . . . . [ ]
   f. Future assignments . . . . . [ ]
   g. Completed assignments . . . . . [ ]
   h. Skills progress checks . . . . . [ ]
   i. Student counseling reports . . . . . [ ]
   j. Duration of lesson session . . . . . [ ]
   k. Time on individual screens . . . . . [ ]
   l. Length of time to complete test(s) . . . . . [ ]
   m. Performance on individual questions . . . . . [ ]
   n. Number of attempts on individual questions . . . . . [ ]
   o. Student responses to individual questions . . . . . [ ]
   p. Number of times student has taken course . . . . . [ ]
   q. Bookmark of where student is in the lesson . . . . . [ ]
   r. Demographics (name, rank, i.d., AFSC) . . . . . [ ]

2. Class record requirements [100]

   a. Average lesson grades . . . . . [ ]
   b. Average block grades . . . . . [ ]
   c. Average course grades . . . . . [ ]
   d. Current assignments . . . . . [ ]
   e. Number of students in class/group . . . . . [ ]
   f. Average time in lesson . . . . . [ ]
   g. Average time in testing . . . . . [ ]
   h. Performance on individual test items . . . . . [ ]

3. Statistical analysis requirements [105]

   a. Test item analysis ..... [ ]
   b. Course validation and/or evaluation data ..... [ ]
   c. Test averages/means ..... [ ]
   d. Standard deviations ..... [ ]
   e. Test score medians and/or mode ..... [ ]
   f. Performance curves ..... [ ]
   g. Data from off-site locations [106] ..... [ ]

4. Report generation requirements [108]

   a. Student progress ..... [ ]
   b. Student evaluation ..... [ ]
   c. Computer utilization rates/time ..... [ ]

5. Maintenance of records/data compiled off site [101] ..... [ ]

6. Length of time needed to maintain records [103]

   a. 0-6 months ..... [ ]
   b. 6-12 months ..... [ ]
   c. 1-2 years ..... [ ]
   d. >2 years ..... [ ]

7. Record access requirements [104]

   a. Daily ..... [ ]
   b. Weekly ..... [ ]
   c. Monthly ..... [ ]
   d. Quarterly ..... [ ]
   e. Annually ..... [ ]
   f. As needed ..... [ ]

8. Interface with other CMI packages [107] ..... [ ]

9. Centralized record keeping [109] ..... [ ]

DECISION N
CMI Support Requirements

Individual Student Record Requirements
Class Record Requirements
Statistical Analysis Requirements
Report Generation Requirements

The data recorded in these sections of your worksheet can be used directly in formulating specifications for the CMI component of your CBT system. Keep in mind, however, that the more types of records you maintain, the greater your system costs will be. You may wish to review these lists again in terms of which capabilities are essential and which would simply be nice to have. Consider the total trade-off of costs for the increased CMI capability versus the savings in instructor and administrative time required to maintain the records.

Maintenance of Records and/or Data Compiled Off-Site

If you indicated that you will need to maintain CMI data from off-site locations, there are several options for how these data can be made available to you. If the records are few and/or small, the off-site locations can simply send printed reports and the data can be keyed in at the main site. It is more efficient, however, if you have a system which will allow you to transport CMI data either via modem or via some magnetic medium, such as floppy disks or magnetic tape; then the data will not have to be re-entered. This also adds to the security of the records.

Length of Time Needed to Maintain Records
Record Access Requirements

Most organizations need to access records frequently for the duration of a course, and seldom afterwards. The length of time you maintain records on the computer will drive the required data handling capabilities of your CMI software and the amount of storage capacity (e.g., hard disk space) you'll need. That is, the longer you keep records, the more you drive up cost--even more so, if individual records are large, or if you have a large number of records. Depending on why you need to maintain those records and how often you actually need to access them, it may be sufficient just to print the records and back up the data on some long-term storage medium, such as magnetic tape (or delete them to provide more storage space on the system). If you must maintain records for more than six months, consider ways of pruning down record size.

Interface With Other CMI Packages

If you are going to need to integrate the CMI records/data compiled from a CMI package which is different from the one you are using, special steps will have to be taken to ensure the

compatibility of the data. Obviously, you will be unable to change the CMI package which the other sites are using. You may wish to take this into consideration when selecting a CMI package for your system. If there is no way of selecting the same CBT system as is being used at the remote sites, and you need to consolidate their data with yours, then you will need to have special interface software written to ensure data compatibility. Sometimes this software is simple to write and to operate, at other times it can be quite complex depending on the degree of similarity of the records stored by the CMI package. Make certain that you have accounted for this interface requirement if one exists.

Centralized Record Keeping

CMI records (student and lesson) can be kept in various forms and may either be distributed or centralized. If training records are currently kept by individual students or even by small groups, the CMI system which you will need can be quite distributed, i.e., records may be kept on a floppy disc, or at an individual computer terminal. If, on the other hand, records are kept in a centralized location, or if it would be impractical or impossible to manage training if records were kept in such a dispersed manner, then you will need to have a centralized CMI system. This has implications for the configuration of the hardware components of the CBT system. The need to centralize record keeping may necessitate the use of a Local Area Network (LAN) or Host computer to bring about this function. When you are evaluating CBT authoring systems as well as hardware you should take these factors into consideration. If you are building a CBT specification you will need to make these requirements very clear in that document.

DECISION O
Evaluation Capabilities

CBT systems rely heavily on evaluations, both to assess student progress, and to tailor lesson presentations for a specific student's needs. Evaluation capabilities come in a wide variety of formats. The kinds of evaluation capabilities of the CBT system that you choose will have a direct impact on your ability to individualize lessons, and therefore, on the quality of training.

The purpose of this section is to help you to determine the evaluation capabilities your system will need to have. You will specify the type(s) of evaluation your system will use, written question formats supported, the degree of flexibility your system will exercise judging responses to written questions, the types of feedback supported, and the extent to which your system will need to monitor students' response time to questions.

This information should be used to assess the capabilities of various authoring systems and to develop the CBT system specification. You should assess each CBT authoring system's capability to meet your requirements. If an authoring system does not meet your requirements, it should be considered for elimination. If you intend to have your CBT system developed by a contractor, this information should be used to develop the system specification to be used to acquire the CBT system.

Instructions

Complete Items 1-6 on Worksheet O by referring to your responses on the Questionnaire. Just mark the appropriate block on the worksheet for each item you checked on the Questionnaire. If an item on the worksheet refers to a question which was not answered on the Questionnaire, write NA (not applicable) beside the item and move on to the next item.

DECISION O
Evaluation Capabilities

1. Types of Evaluation [57]
   - a. Written ..... [ ]
   - b. Oral ..... [ ]
   - c. Performance ..... [ ]
   - d. Simulation ..... [ ]

2. Written Question Formats Supported [58]
   - a. Multiple choice ..... [ ]
   - b. True/False ..... [ ]
   - c. Matching ..... [ ]
   - d. Short answer ..... [ ]
   - e. Fill-in-the-blank ..... [ ]
   - f. Essay ..... [ ]

3. Acceptable Variations to Open-ended Written Question Responses [60]
   - a. Spelling ..... [ ]
   - b. Synonyms ..... [ ]
   - c. Spacing ..... [ ]
   - d. Punctuation ..... [ ]
   - e. Abbreviations ..... [ ]
   - f. Upper or lower case ..... [ ]
   - g. Exact answer only [59] ..... [ ]

4. Types of Feedback Supported [61]
   - a. Correct/incorrect ..... [ ]
   - b. Prompt/hint ..... [ ]
   - c. Response specific guidance/explanation ..... [ ]

5. Requirement for measurement of time intervals [95] ..... [ ]

6. Requirement for real-time response [96] ..... [ ]

DECISION O
Evaluation Capabilities

Interpretation

Types of Evaluation

This document distinguishes between four types of evaluation: written, oral, performance, and simulation. Written evaluation, as defined here, involves the use of text-based questions, such as multiple choice, true/false, and so on. Oral evaluation involves the testing of behaviors that must be spoken to be evaluated, such as the ability to speak a foreign language. Performance evaluation can involve the use of CBT to test skills, such as the ability to find a fault in a circuit. Performance evaluation does not usually involve the use of text-based questions. For example, evaluating someone's ability to complete a flight checklist can be accomplished via interactive video, with the user touching each instrument to be checked in succession. Touch screens, light pens or other kinds of pointing devices can be used to respond to this type of performance evaluation. A touch screen might be used if the job required the student to actually touch the object with a finger. Since touch screens are usually more expensive than other pointing devices, be sure that you actually need that capability. For example, a maintenance technician often uses a probe of some sort to touch and identify or test equipment components. A touch screen would probably be inappropriate, but a light pen might approximate the technician's probe. The action of using a probe corresponds very closely to the use of a light pen as a pointing device, and is much cheaper than a touch screen. A mouse or track ball can both be used to move a marker or point across the screen. If one of these devices is similar to what the students will be using on the job, you should consider selecting such a device. Otherwise each device has its own advantages and disadvantages.

A simulation of the actual experiences encountered on-the-job can provide one of the most realistic evaluation tools available on CBT. You should not be frightened off by using simulations for testing. The purpose of the simulation, in almost every case, is to determine if the student is able to recognize decision points within the simulation, and then to make the right choice. These complex variables can be broken down for the "whole" of the simulation, to the various parts which are frequently testable by traditional questioning techniques. Once we recognize that the simulation is dependent on the selection of decisions, it becomes much easier to make use of this type of testing.

Although all four types of evaluation can be accomplished to some extent via CBT, the most commonly used form of evaluation in CBT is written evaluation, or a combination of written and performance evaluation. Almost all off-the-shelf CBT systems provide the capability for a variety of different forms of written evaluation. If you plan to incorporate oral or performance evaluation in your CBT system, you should think through exactly how you wish to evaluate those behaviors, because you may not be able to find an off-the-shelf system which does exactly what you require. Referring to the outcome of Decision A may help you to determine which of your objectives lend themselves easily to being evaluated via various CBT techniques.

Written Question Formats Supported
Acceptable Variations to Open-ended Written Question Responses

The items that you have checked off in these two sections constitute your requirements for question handling capabilities in your CBT system, based on the types of written question formats currently in use. You may also wish to consider new options for questioning and testing. CBT is quite a different medium from paper-and-pencil-based tests, and can provide many different options for interaction with the student. You may wish to allow your students opportunities for simulation and experimentation, as well as traditional question formats.

Feedback

The items listed under "Feedback" on your worksheet constitute a general definition of the level or quality of feedback you would like your system to have. However, feedback is only partially a function of your CBT system's capability to support feedback; it is also -- and perhaps primarily -- a function of your instructional developers' skillful use of feedback in the lessons. Therefore, you should not only make sure your system supports the level of feedback you want; but you should also make sure your developers (whether in-house or contracted) provide the level and quality of feedback that is instructionally effective.

Response Time
Requirement for Real-time Response

One of the advantages of CBT is that it can allow students to proceed through a lesson at their own pace. However, sometimes you may need the capability to require that a student respond to a question within a particular amount of time, such as within the time constraints actually experienced on the job. A "Yes" response to Item 5 indicates that you require the capability to have a student respond to a question within a specific time interval. A "Yes" response to Item 6 indicates specifically that you require your CBT system to operate in real-time mode. (The difference between Items 5 and 6 is that the additional requirement to respond in real-time may require a more advanced system.) Consider these factors particularly if you intend to develop simulations whether for testing or training. The more realistic a simulation is, i.e., the more real time, the better the student will be able to appreciate the stress factors under which he/she will have to perform on-the-job.

DECISION P
Number of Terminals Required

The purpose of this decision is to help you to determine how many terminals your organization will require for courseware delivery, development, and maintenance. Worksheet P will help you determine how many terminals are required for each function and the total number of terminals required.

In addition to the Questionnaire, this decision will also utilize information from Decisions C, D, E, F and G. The worksheet for this decision is located after the instructions and interpretation.

Instructions and Interpretation

Number of CBT Courseware Delivery Stations Required

In this section, you will estimate the number of courseware delivery stations required. This figure will be equal to the number of student stations plus the number of instructor stations, if any. As used in this document, instructor stations are stations used by instructors to monitor student progress, check student grades, and perform other typical instructor functions; they are not assumed to be the same stations used for courseware development or maintenance.

Instructions (for Worksheet P, Items 1-9)

1. Refer to Worksheet C. Use either Item 3 or 6 from Worksheet C depending on whether you are planning CBT for a single class or multiple classes.

2. Refer to Worksheet E.2 for the total CBT hours.

3. Multiply Item 1 by Item 2, and write the result in this blank. This figure represents the total number of contact hours that students will need to spend using CBT.

4. Refer to question 41 on the Questionnaire. This figure represents the period of time the instruction will be available in days.

5. Refer to question 42 on the Questionnaire. This figure represents the amount of time, in hours, that CBT will be used per day.

6. Multiply Item 4 by Item 5, and write the result in this blank. This figure represents the total number of hours your CBT system will be available for student use.

7. Divide Item 3, "Total student CBT contact time" by Item 6, "Total hours of CBT availability." Round up the result to the nearest whole number and enter it in the space provided. This figure represents the total number of student delivery stations required.

8. Refer to questions 55 and 56 on the Questionnaire. Normally, one instructor station is sufficient for one or two instructors who will be monitoring a class of about 10 people each; there are exceptions to this rule-of-thumb. If the answer to either question 55 or 56 is **Yes**, you will need to estimate the number of instructor stations that will be needed in a single classroom at any one time. Write the estimated number of instructor stations required in the blank provided by Item 8.

9. Add Item 7 and Item 8, and write the response in the blank provided. The result will be an estimate of the <u>total number of CBT delivery stations required</u>.

Number of CBT Development Stations Required

The number of CBT development stations required depends on whether or not you intend to develop CBT in-house. If you choose to hire a contractor to develop CBT for you, then you should allow them to determine how many CBT development stations they will need, and they will price it into their proposal. If you choose to develop CBT in-house, however, you will probably need as many machines as you have personnel available who can use them.

You will need information from Decision F, "In-house CBT Development," to complete this section.

<u>Instructions (for Worksheet P, Item 10)</u>

10. If the outcome of Decision F is a decision <u>not</u> to pursue CBT development in-house, then enter a 0 on this line and move on to Item 11, "Number of CBT Maintenance Stations Required." Otherwise, refer to Worksheet D, "Staff Needs." The number in the **Availability** column for Item 8 on Worksheet D can be used to estimate the required number of CBT development stations. Write this number in the blank provided by item 10 on Worksheet P.

Number of CBT Maintenance Stations Required

The number of CBT maintenance stations required depends on whether or not your organization intends to maintain courseware in-house. You will need to refer to Decision G, "In-house Instructional Maintenance Support," to complete this worksheet.

Instructions (for Worksheet P, Item 11)

Note: If the outcome of Decision G is a decision not to provide in-house instructional maintenance support, enter a zero by Item 11 of this worksheet and move on to the Interpretation section for Decision P. Otherwise, proceed to the instructions below.

11. Having completed Decision G, you should have an idea of how many staff you will need to maintain your CBT courseware. Normally, you should have one station available per staff member who will be working on maintaining the instruction. Estimate the number of maintenance stations you will need and write this number in the blank provided.

Total Number of Stations Required

Instructions (for Worksheet P, Item 12)

12. To find out the total number of courseware delivery, development, and maintenance stations required, add the figures obtained from Items 9 through 11 on Worksheet P. Enter the result in the blank provided. You should use Item 10 if you are going to develop the courseware in-house. However, if you do not intend to develop the courseware but you do intend to maintain it, line 10 should be zero and you should use the figure on line 11.

DECISION P
Number of Stations Required

Interpretation

Number of CBT Courseware Delivery Stations

The number of CBT courseware delivery stations needed to match your requirements is indicated in Item 9 of Worksheet P. This figure will provide you with the minimum number of terminals required to accommodate your students and instructors. You may need to adjust this number to account for such things as the use of CBT laboratories which cannot handle all of the terminals at once. For example, if the worksheet indicates the need for 97 terminals, yet your facilities can only adequately house 15 terminals in one room/laboratory, either you may need to round your number up to 105 (using the additional terminals for expansion/surge capability) or down to 90 (by adjusting upward the number of hours that the students will be able to utilize the stations). Many external factors such as these should be taken into account before deciding on the final number of CBT delivery stations required. However, you should realize that the cost of terminals should not be a determining factor in deciding how many stations you will need, because equipment costs have a far less degree of impact on the overall cost of CBT than courseware development costs.

Number of CBT Development Stations

The number which you entered for Item 9 was derived by adding the number of staff available (in man-years per year) to do various CBT development tasks. This number may or may not accurately represent the actual number of staff who will need to have access to a computer at any given time, especially if you have personnel who will be performing more than one type of task, or if you have several personnel who are only available for a short time. You may need to make adjustments to this number, depending on your situation. Given the fact that development costs generally far exceed equipment costs, however, it is better to err in the direction of having more equipment than you need than less.

Number of CBT Maintenance Stations

Depending on how you schedule your CBT maintenance activities, you may or may not need one machine per staff member -- one machine per two or three staff members may be sufficient. You may wish to adjust your numbers accordingly.

Total Number of CBT Stations Required

The figure in Item 12 should equal the total number of stations required for CBT development, delivery, and maintenance. This figure was calculated by treating development, delivery, and maintenance as separate activities using separate sets of stations. It is possible that the same stations can be used for several different activities. For example, you might want to use some

of your delivery stations for development and maintenance, and simply do without those stations while CBT development and/or maintenance activities are taking place. This would allow you to purchase fewer machines. However, you should remember that equipment costs are minor in comparison to labor costs. If personnel must spend time waiting for equipment, then you are not saving anything by buying less equipment.

DECISION P
Number of Stations Required

1. Number of students taking CBT at any one time [from Worksheet C] . . . . . _____

2. Amount of courseware in hours [Worksheet E] . . . . . x_____

3. Total student CBT contact time [Item 1 x Item 2] . . . . . =_____

4. Period of time instruction is to be available in days [41] . . . . . _____

5. Hours of CBT system usage per day [42] . . . . . x_____

6. Total hours of CBT availability . . . . . =_____

7. Number of student stations required [Item 3 divided by Item 6] . . . . . =_____

8. Number of instructor stations required [55, 56] . . . . . _____

9. Number of CBT courseware delivery stations required [Item 7 + Item 8] . . . . . =_____

10. Number of CBT development stations required [Worksheet D, Item 8 and Worksheet F] . . . . . =_____

11. Number of CBT maintenance stations required [Worksheet G] . . . . . =_____

12. TOTAL NUMBER OF CBT STATIONS REQUIRED [Item 9 + (Item 10 or Item 11)] . . . . . =_____

DECISION Q
Communication/Network Support Requirements

Communication and network support refers to the need for the CBT system to communicate with other systems or to share resources. For instance, computing resources, memory allocation, or courseware may need to be shared among users of the proposed system or divided between this and other systems. In both cases, there are specific hardware and software considerations and choices that must be made and addressed in your CBT system specifications. The worksheet which accompanies this section will help you determine whether communication or network support needs to be a part of your CBT system configuration to help you in this effort.

In addition to the questionnaire, this decision also utilizes Worksheet C.

Instructions

1. Refer to Worksheet C. On that Worksheet you calculated the "Average number of students who would be using CBT at any one time," i.e., either Item 3 or Item 6. Enter the number you calculated there in the space provided under Item 1, "Within a Class" on Worksheet Q.

   Refer to questions 53 and 54 on the Questionnaire. If the answer to either of these questions is **Yes**, mark the block corresponding to "Shared courseware" under Item 1 on Worksheet Q.

   Refer to questions 55 and 56 on the Questionnaire. If the answer to either of these questions is **Yes**, mark the block corresponding to "Instructor monitoring" under Item 1 on Worksheet Q.

2. Refer to Worksheet C, Item 5. Enter the number of classes using the CBT system at any one time in the space provided under Item 2, "Within a Training Center" on Worksheet Q.

   Refer to question 48 on the Questionnaire. If options **b or c** have been selected, refer back to question 47. Otherwise, proceed to Item 3.

   If options **a or b** have been selected (for question 47), mark the block corresponding to "Software" under Item 2, "Within a Training Center." If options **c or d** have been selected, check the box corresponding to "Hardware." If option **e** was selected or if the answer to question 109 on the Questionnaire is **Yes**, check the box "CMI data."

3. Refer to question 48 on the Questionnaire. If option **d** was selected, refer back to question 47. Otherwise, you have completed Worksheet Q and may proceed to the Interpretation section.

If options **a or b** have been selected (for question 47), mark the block corresponding to "Software" under Item 3, "Across Training Centers or Other Locations." If options **c or d** have been selected, check the box corresponding to "Hardware." If option **e** was selected, or if the answer to any of the questions 101, 106 and 109 on the Questionnaire is **Yes**, then place a mark in the block labelled "CMI data." If the answer to any of these questions is **Yes**, place a mark in the box corresponding to "CMI data" under the heading "Across Training Centers of Other Locations."

Refer to question 49 on the Questionnaire. If the answer to this question is **Remote**, and the response to question 50 is **Yes**, place a mark in the box labelled "Remote Access" under Item 3 on Worksheet Q.

DECISION Q
Communications/Network Support Requirements

1. Within a Class

Number of students using CBT system at any one time [Worksheet C] ..... _____

Shared courseware [53, 54] ..... [ ]

Instructor monitoring [55, 56] ..... [ ]

2. Within a Training Center

Number of classes using CBT system at any one time [Worksheet C, Item 5] ..... _____

Shared system capabilities

Software (authoring system, courseware) [47, 48] ..... [ ]

Hardware (computers, processing capabilities, storage) [47, 48] ..... [ ]

CMI data [109] ..... [ ]

3. Across Training Centers or Other Locations

Shared system capabilities

Software (authoring system, courseware) [47, 48] ..... [ ]

Hardware (computers, processing capabilities, storage) [47, 48] ..... [ ]

CMI data [101, 106, 109] ..... [ ]

Remote access [49, 50] ..... [ ]

DECISION Q
Communications/Network Support Requirements

Interpretation

This worksheet is not an attempt to identify system components that must be purchased to accommodate the sharing of software or data. Rather, it is an attempt to help you determine your system's needs in these areas. For specific input regarding the type of networking or communication support your system requires, you should consult a computer systems analyst who is familiar with the type of hardware you are interested in using, e.g., if minicomputers will be used, speak to an expert on minicomputers.

Within a Class

In looking at the worksheet, you will see three areas: 1) number of students using CBT system at any one time; 2) shared courseware; and 3) instructor monitoring. Each of these variables impacts the need for communication or networking support within a classroom. Obviously, if there is a need to share courseware among students, or if an instructor needs to monitor student progress via computer, the delivery stations must be linked together. If these blocks are marked on the worksheet, communication and/or networking support will be needed by your system. Be careful in marking the "Instructor monitoring" block. A mark in this block indicates the need to monitor the student while he/she is actually taking a CBT lesson. Electronic monitoring of student progress can be an expensive option to a CBT system. The much less expensive option is to have the instructor circulate among the students while they are working to monitor their activities "over-the-shoulder."

As far as the number of students using the system at any one time is concerned, this is really a courseware and CMI logistics issue. If a number of stations will deliver the same courseware, it is far easier to maintain this courseware (and install the revised versions) on a central computer, as opposed to loading the courseware on a large number of stations. The same is true of CMI data collection. If student response data will be accumulated on a group of students taking lessons at the same time, it is much simpler to gather this information at one central location rather than going to each station to obtain the data. Usually, if the number of students using the system at one time is greater than ten (10), some form of networking should be considered. If you are going to use microcomputers, like so many of those who are using CBT opt to do, you should look into establishing a local area network (LAN). A LAN can be quite effective for linking a moderate number of terminals (10-15) together for CBT. You should consult a computer systems analyst for more detailed information on LANs. Also, be sure to check that the CBT authoring system which you will be using can operate on a LAN.

Within a Training Center

Determining whether communication and/or networking is necessary within a training center is much like selecting this capability for a classroom. If a number of classes will be using the same courseware and these classes will be run concurrently, some type of networking support between the CBT classrooms may be desired. If this number is three or greater, you should investigate the possibility of linking these systems and sharing resources. If there is a need to share system capabilities, whether in the form of software, hardware or CMI data collection and analysis, the possibility of implementing some type of network, e.g., local area network using personal computers (PCs) or a minicomputer system, should be seriously considered. If any of the blocks under "Share system capabilities" are marked, this option should be explored.

Across Training Centers or Other Locations

Just as in the two cases just discussed, communication or networking of system capabilities across training centers or other locations (headquarters, command centers, vendors, etc.) is important when defining your CBT system requirements. Training can be conducted in diverse geographical sites and monitored from a central location. Computer processing and storage capabilities can be used to avoid the purchase of expensive equipment while still enjoying the benefits, e.g., mainframe wide area networks. Student data and other CMI data can be accessed from training centers across the globe. When vendor support is needed, system access can be granted so technicians can walk you through difficult or complex troubleshooting. If any of the boxes on the worksheet under this heading are marked, thoughtful consideration should be given to these needs. There are a number of ways to meet these communications requirements, some of which may already exist at your facility. You need to consult an expert for more detailed advice.

DECISION R
Computing Capability Requirements

The computing capability, or processing speed, of a computer affects the amount of work it can perform in a given amount of time. A computer with a higher processing speed can process more data in a given amount of time than a computer with a lower processing speed can. This means it can handle more users, complex calculations, and so on, without a significant degradation in response time.

The processing speed of the computers used for the development and delivery of courseware can impact the development cost and quality of the delivery. The purpose of this decision is to help you organize information about your requirements so you can have a better idea of the degree of computer capability you will need. Of course, you may be forced into selecting a certain computer because of circumstances beyond your control, e.g., the requirement to purchase only those computers listed on the Air Force standard small computer contract. If this is the case, you will need to assess what effect such computers will have on your courseware. If the computers are of a moderate to slow speed, you may need to reduce the amount of complex graphics or simulation you had planned to improve overall system performance. If the computers are of a faster speed than the machines being used for development, be sure to try out your lessons on them. Some of your time delays or animations may not work just right.

In order to determine the computing capability which your CBT system will require, you will have to consider four primary factors: 1) the number of users, 2) the total amount of data to be stored on the system, 3) the functions to be performed by the system, and 4) the various kinds of data which must be stored or processed. Each of these factors will be discussed in more detail in the interpretation section.

You have already calculated some of this information in the other worksheets of this document. That information will be gathered together here to help you determine the amount of computing capability which you will require. The reason for gathering it all together here is to allow you to assess all of this information as it will impact the power of the computational system required for your training requirements.

You will need to refer to worksheets from the following Decisions in completing Decision R:

C	Student Needs
E	Type of CBT Technology Required
I	Graphics Support Requirements
K	Audio Support Requirements
L	Video Support Requirements
P	Number of Stations Required

Instructions

1. Refer to Worksheet C. There you calculated the "Average number of students who would be using CBT at any one time," either Item 3 (Single Class) or Item 6 (Multiple Classes). Use that figure here.

2. Refer to Worksheet P. There you calculated the "Number of delivery stations required (Item 9). Use that figure here.

3. Refer to Worksheet E.2. There you calculated the "Total CBT Hours," (Item 6). Use that figure here.

   Note: These three figures should give you an overall impression of the size and volume of CBT which your system will need to handle.

4. Refer to question 38 on the Questionnaire. Write the number of students per year in the space "Number of records per year" under Item 4 on Worksheet R.

   Refer to question 103 on the Questionnaire. Record the length of time these records must be maintained in the space labelled "Length of Storage."

   Refer to question 105 on the Questionnaire. If statistical analyses will be necessary, indicate this by checking the block for "Statistical manipulations required."

5. Refer to Worksheet I. If graphics support is needed to support the training requirements, indicate this by recording the level of graphics support you calculated on Worksheet I, Item 1.

6. Refer to Worksheet J. If animation support is needed to support the training requirements, indicate this by recording the level of animation support you calculated on Worksheet J, Item 1.

7. Refer to Worksheet K. If audio support is needed to support the training requirements, indicate this.

8. Refer to Worksheet L. If video support is needed to support the training requirements, indicate this by recording the level of video support you calculated on Worksheet L.

9. Refer to Worksheet E.2. If simulation support is needed to support the training requirements, indicate this by recording the percentage of simulation support you calculated on Worksheet E.2, Item 1.

Refer to question 54 on the Questionnaire. If the answer to this question is **Yes**, indicate that the simulation equipment requirements are complex by marking the block under item % on Worksheet R.

10. Refer to questions 94, 95 and 96 on the Questionnaire. If any of these questions is answered **Yes**, mark the box for Item 10 "Real-time-responses," on Worksheet R.

DECISION R
Computing Capability Requirements

1. Average number of students using CBT at any one time [Worksheet C] . . . . . _____

2. Number of CBT courseware delivery stations [Worksheet P, Item 9] . . . . . _____

3. Total CBT hours [Worksheet E.2] . . . . . _____

4. CMI

   Number of records per year [38] . . . . . _____

   Length of storage [103] . . . . . _____

   Statistical manipulations required [105] . . . . . Yes [ ] No [ ]

5. Level of graphics support required [Worksheet I, Item 1] . . . High [ ] Moderate [ ] Low [ ] None[ ]

6. Level of complexity of animation required [Worksheet J, Item 1] . . . . . Complex [ ] Simple [ ]

7. Audio support required [Worksheet K] . . . . . Yes [ ] No [ ]

8. Video [Worksheet L] . . . . . Yes [ ] No [ ]

   Stills . . . . . Yes [ ] No [ ]

   Motion . . . . . Yes [ ] No [ ]

   Simultaneous presentation . . . . . Yes [ ] No [ ]

9. Simulation support required [Worksheet E.2] . . . . . _____%

   Complex simulations [54] . . . . . Yes [ ] No [ ]

10. Real-time responses [94, 95, 96] . . . . . Yes [ ] No [ ]

DECISION R
Computing Capability Requirements

Interpretation

After completing Worksheet R, you will have assembled a list of all the requirements of your proposed CBT system which will impact the degree of computing capability you require. The purpose of this section is to help you to gain some idea of the degree of computing capability you will need, based on the factors you identified on the worksheet.

In determining required computing capability, there are essentially four areas to consider: 1) the number of users accessing the courseware at any one time; 2) the amount of information stored on the computer; 3) what the computer will be required to do in terms of development and delivery; and 4) the requirements for processing information. Each of these is discussed briefly in the following sections. In general, the greater your need in any of these four areas, the more computing capability you will require. Look through the following interpretation sections, then assess the kind of computing compatibility you will require.

Number of Users

For stand-alone systems (those that are not linked electronically), the number of users accessing the courseware authoring or delivery system is not relevant. However, if CBT terminals are networked in some fashion, this becomes an important consideration. The rule of thumb here is: the more users on the system at any one time, the slower the access time for any single user. If your networked system will need to accommodate more than 15 users, increased computing capability should be considered. A personal computer can be dedicated to serve as a file server on a network, but when the number of users exceeds 15 the entire network slows down dramatically. You should consider using a high speed 386 or 486 machine for these applications. Better than either of these is a dedicated file server which is designed specifically to run a network.

Amount of Information Stored

The computing capability of a computer can also degrade when large amounts of information are stored. This is true regardless of the type of hardware or its configuration (stand-alone or networked). It is also true whether the storage device is a floppy disk or a hard disk. The storage space taken by the CBT development and delivery software is usually nominal when compared to the space which must be allocated for courseware, graphics, animation, digitized images, and CMI data. Complex graphics, animations, images, branching, etc. are usually memory hungry and will use large blocks of storage. The general rule is: the more information stored on any device (floppy, hard drive, or tape), the longer it will take for the computer to find and access that information. [Note: Computing capability for a hard disk is also influenced by

the access speed of the hard drive itself. If the drive's access speed is slow, the computing speed of the computer will be affected regardless of the amount of information stored.[1]

Type of Development and Delivery

When developing or delivering courseware, the computer has to access many pieces of information almost simultaneously to present a frame of instruction. When this process involves text presentation only, the computing capability of the system is generally not affected. But, when other types of presentation, development, or delivery are thrown in, the computer can become bogged down. This is especially true when the presentation is high definition (which requires many more pieces of information to compose one image) and/or animation (several images strung together). In addition, when the computer is called upon to access peripheral equipment, e.g., laserdisc player, audio device, etc., its speed may slow down. In this case, the rule is: the more sophisticated the presentation, the more computing capability required to maintain an acceptable response time.

Information Processing

A similar rule applies to the type of information processing required by the system: the more sophisticated the processing, the more computing capability required to maintain an acceptable response time. In other words, the more you ask the computer to do at any one time, the more time it will take to do it. If a simulation using audio, motion video, and high resolution graphics is going to be shared among a group of users on networked stations, a degradation in presentation speed will almost certainly be experienced. This can also happen if the response processing of student input, whether manual or oral, is occurring simultaneously with presentation of other information. Essentially, the computer has to "check" the student's answer against all possible correct responses, find the appropriate feedback, deliver this to the student in some form, while finding the textual material, graphics, animation, etc., associated with the feedback frame. If this process needs to occur in a real-time, the impact on the computing capability becomes even more acute.

DECISION S
Equipment Required

In this section, you will generate requirements for equipment for your CBT system, such as you might include in a system specification. The type of equipment required by the proposed CBT system will depend heavily upon the training requirements and the type of CBT presentation you have previously determined to be necessary. For this reason, the decisions made in this section will rely heavily upon several previously completed decisions as well as the questionnaire. The worksheet for this decision will be divided into four sections: 1) Computer System; 2) Storage Devices; 3) Input Devices; and 4) Output Devices. By completing the worksheet, you will develop a listing of some of the more important components needed for your CBT system.

To complete Worksheet S, you will need to refer to the following decisions:

E	Type of CBT Technology Required
H	Text Support Requirements
I	Graphics Support Requirements
J	Animation Support Required
K	Audio Support Requirements
L	Video Support Requirements
P	Number of Terminals Required
Q	Communications/Network Support Requirements
R	Computing Capability Requirements

This worksheet is a little different from those you've previously completed, in that you will be required to make decisions about the type of hardware you need to purchase, rather than simply prescribe needed capabilities. We have tried to provide you enough information to help you make correct decisions, but you may also find it helpful to work through this section with someone who is familiar with computer systems.

[Note: This section will not attempt to address cameras, tape recorders, editing equipment, or any other types of video or audio production devices; the focus is on computer equipment.]

Instructions

1. Computer System

The type of computer system selected to host the CBT is paramount to other hardware and software decisions. This decision will decide, in part, what type of peripheral equipment is required or allowable (monitors, printers, pointing devices, etc.) and what type of software may be used for development and delivery.

Generally speaking, there are three classes of computer systems available: microcomputers, minicomputers, and mainframes. Microcomputers tend to be smaller, cheaper, and less powerful than minicomputers; and minicomputers are likewise, smaller, cheaper, and less powerful than mainframes. Despite their lack of power relative to the other two classes of computers, however, microcomputers are powerful enough to handle all ordinary CBT applications. As a matter of fact, they are usually far preferable for CBT than mainframes or minicomputers. For this reason -- and because microcomputers are less expensive -- it is frequently recommended that microcomputers be utilized for CBT systems. The primary reason why you might choose to host CBT on a minicomputer or mainframe would be if you already had such a system in place for some other purpose, and you prefer to use it rather than purchase new equipment. Remember that using a mainframe for CBT usually means slower response time and less graphics capability.

Microcomputers can be utilized in either a stand-alone or a networked type of configuration. In a stand-alone configuration, microcomputers are not linked; each microcomputer has access only to software, lessons, and student data which have been stored on that computer. In a networked configuration, microcomputers are electronically linked to a "file server." A file server is a microcomputer or piece of hardware housing specialized software which serves as a centralized storage place for software, lessons, and data; it also enables some degree of communication between microcomputers on the network. As a rule-of-thumb, if you plan to have ten (10) or more CBT stations active at the same time (refer to Decision P for the number of delivery stations you require and to Decision Q for communication and/or sharing information), you should probably utilize networked microcomputers.

Given the information presented above and the outcome of Decision Q, determine what type of computer your training system will require. After making your decision, mark the appropriate block under Item 1, "Computer System," on Worksheet S. Also note in the space to the right how many stations will be needed (from Worksheet P). If networked microcomputers are used, you should also indicate the need for a file server (e.g., 30 stations plus 1 file server). Get some technical advice when determining how many file servers will be required for your CBT system. There is no "rule-of-thumb" for the ratio of file servers to terminals. Each network operates a little differently, therefore you will probably need some specific technical advice.

2. Storage Devices

The purpose of this section is to help you to identify what types of storage devices you will need for your CBT system. Storage devices allow you to store all the information needed for, or generated by, CBT. Typically, a CBT system needs to be able to store applications software (e.g., operating system software, authoring software), lesson material (including text, graphics, and video), and CMI data (i.e., student records).

The types of storage devices you will need depends to a great extent on the volume of data which you will require the system to store. A rough estimate of required storage capacity (in M, or megabytes) can be obtained by use of the following formula:

Formula for Required Storage Capacity (R)

$$R = S + A + (L * X) + (C * X * Y * Z)$$

where:

Abbreviation	Meaning	Capacity Required	
S =	System software	=	.5M
A =	Authoring software	=	2.0M
L =	Lessons (per hour of CBT)	=	.3M
C =	CMI data (per student per hour of CBT)	=	.02M

X = Hours of CBT (see Worksheet E) . . . . . _____

Y = # of Students per Class (see Worksheet C) . . . . . _____

Z = Number of Classes whose records will be on the computer at any given time (see Worksheet C) . . . . . _____

This formula will provide you with a rough estimate of storage requirements. You may have to adjust the given values for S, A, L, and C to fit your particular situation. For example, if, in the rare circumstance, you do not intend to store CMI data, then C will equal zero. Or, if your lessons utilize sophisticated graphics and branching, they may take up more space than the .3M allotted here. After calculating the Required Storage Capacity (R), write the result in the space labelled "Required Storage Capacity" under Item 2 on Worksheet S.

Note: If you will be using minicomputers or mainframes, you should inform your system administrator about your Required Storage Capacity (R), and the types of information that you will be storing (e.g., text, graphics, video), and work with him or her to identify the

type of storage you will need. You do not need to continue with this section, and may move on to Item 3, "Input Devices," at this time.

If you use microcomputers in either a stand-alone or a networked configuration, continue reading this section. Table S-1 describes the types of storage devices available for microcomputers. The sections following will help you to identify which and how many of these storage devices your system will require.

MICROCOMPUTER STORAGE DEVICES

Storage Device	Storage Capacity	Storage/Retrieval Speed	Description	Primary Usage
Floppy Disk Drive	Low	Slow	Two drive sizes: 3.5" and 5.25". Each offers low density (LD) storage and high density (HD) storage. Currently, the 3.5" HD drive and the 5.25" HD are the standards.	Used to transport software and data between independent stations. HD sometimes used to store system hard drive backups.
Hard Disk	Medium to High	Fast	Enclosed device, internal or external to the computer. Offers high density storage, but total capacity is dependent upon the size of the drive.	Used to store large amounts of information including software programs and data files.
Magnetic Tape Back-up	Medium to High	Very Slow	ed device, internal l to the computer. Storage density is u ally high, but depends on the tape size.	Used to store system hard drive backups of large amounts of formation.
Optical Disc Reader	High to Very High	Slow to Medium (Retrieval only)	Two type: CD-ROM and disc. Requires optical laser reader device. Storage capacity is high, but, usually, professional mastering of the disk is required for writing data to the disk. Used primarily to store video images.	Used to store text, audio and video images. Used primarily for interactive video presentations.

TABLE S-1

A. Floppy disk drive. Every microcomputer has at least one floppy disk drive. If you have hard disk drives on all your machines, one floppy drive per machine is usually sufficient. In addition, if you need to copy disks often, you may wish to have one machine per classroom or work area which has two floppy drives. Or, if you do not have a hard disk on a machine for some reason, you should have at least two floppy disk drives on that machine.

Until recently, 5.25" disk drives have been the standard, but 3.5" disk drives have rapidly caught up and will probably become the standard in the future. This is largely because 3.5" floppy disks are more durable and can hold more data than 5.25" floppy disks. If you rely primarily on hard disks, it does not really matter which size of floppy disk drive you choose to adopt for your CBT system, as long as that size becomes the standard on every station within that system. However, many organizations still have and use 5.25" disk drives; therefore, if you frequently need to exchange programs, lessons, or data with other organizations, you should probably have at least one machine per work area which has one of each size of floppy drive.

High-density drives can usually read both high and low-density disks; low-density drives can read only low-density disks. It is probably better, in terms of flexibility, to use high-density drives if possible, but low density drives are cheaper. If you are going to make heavy use of your disk drives, you should probably get high-density drives; if you use floppy disk drives only occasionally, low density drives may be sufficient for your needs.

You should note in the space beside "Floppy Disk Drive" under Item 2 on Worksheet S how many you will need and their general characteristics (e.g., one HD drive per station; one HD drive per delivery station, two HD drives per development station; etc.)

B. Hard disk drive. Although it is possible to use a computer productively without having a hard disk drive, not having one limits your options drastically. Some authoring software is so extensive that you must have a hard disk drive in order to use it. In any case, using a hard disk drive is almost always faster and more convenient, because you do not have to bother with inserting and removing floppy disks, and because the computer can access the data on a hard drive more quickly than it can access the data on floppy disks.

If you are utilizing stand-alone microcomputers to deliver CBT, and if you are not interested in storing student records, it may be possible for you to "get by" without a hard drive with certain authoring software packages. Generally, these packages allow you to create "turn-key" lesson disks which you can just insert into a machine and view. But your priority should be on obtaining software with authoring features which meet your instructional needs, rather than on avoiding the purchase of hard drives.

If you are utilizing stand-alone microcomputers, and you need to determine how large a hard disk you will need, refer to the "Formula for Required Storage Capacity." For

student terminals the required storage capacity can be computed using this modified formula:

$$R = S + (L * X) + (C * X * Z)$$

This formula will provide you with the appropriate number of megabytes required for each terminal. Since hard disks come in standard sizes, e.g., 10, 20, 40, 80, 120, etc., you should select the size which is suitable for your student terminals (round up).

If you are utilizing stand-alone microcomputers, and need to determine whether you can use floppy discs to delivery the training, you will need to refer to the above formula. If (L*X) and (C*X*Z) can be reduced to smaller amounts by letting the "Hours of CBT" equal "1" or less, then the CBT may be subdivided sufficiently to use floppy disc systems, i.e., increments of 720K or 1.44M for 3.5" floppies, or 360K or 1.2M for 5.25" floppies. You must balance this lowered hardware requirement with the increased floppy disc management system which you will have to develop and implement. In other words, each student will require a separate floppy disc for each lesson. Student management will also be complicated, since an individual's records will be dispersed across numerous floppies. Course evaluation and item analysis will also be complicated because of the very same reason.

If you are utilizing networked microcomputers, your network file server should have a storage capacity of at least R (based on the formula on page 110). In addition, it is recommended that each station sharing the network should also have at least a small (10 or 20 megabyte) hard drive to store the networking software and to be used as a backup for lesson files, if the network suffers a failure.

If you intend to use hard disk drives on your CBT system, check the block marked "Hard disk drive" under Item 2 on Worksheet S. You should also note to the side how many and what sizes of hard drive you require (e.g., one 150M hard drive for the file server and one 20M hard drive for each delivery station).

C. Tape drive. Tape drives are used primarily for backing up data from hard drives; so if you do not intend to use a hard drive, you will not need a tape drive either.

Tape drives can be used to selectively back up data from a hard drive. For example, you may periodically back up student record data to tape so that you can purge those records from the hard drive, thus freeing up that space for additional records to be stored. Or, you may want to back up everything on a hard drive periodically just so you have a copy in case of a hard disk failure.

You should probably buy a tape drive for every machine that has a hard drive which contains a large amount of continually changing information, e.g., the file server on a

network. There are also external tape drives, which can be plugged into a station, and when the backup is complete, moved to the next one. During CBT development, for example, you will probably require a tape drive for every development station (if stand-alone) or for the file server (if networked) -- because at this point, your lessons are constantly being changed. After CBT implementation begins, you will require a tape drive for the file server (if networked), because student records are constantly being updated. If your CBT is being delivered via stand-alone microcomputers, you can use a tape drive; but your data collection needs probably won't merit one.

If you intend to purchase tape drives for your CBT system, check the block marked "Tape drive" under Item 2 on Worksheet S. You should also note to the side how many tape drives you will require. You will need to ensure that the tape drives that you purchase are compatible with the computers that you will be using. Not every tape drive works with every computer.

D. Optical storage devices. Optical storage devices are needed if your CBT lessons utilize either still or motion video. Although they are grouped with the other storage devices in this section, optical disc readers do not store computer output as the others do. Optical discs are usually read-only media, meaning that their contents must be pressed onto the disk by outside production facilities, and once pressed, cannot be altered.

CD-ROM drives utilize 4.75" compact discs as a storage medium; videodisc drives utilize an 11" record album-sized disc. CD-ROM drives are used primarily for textual information and video stills. At present, videodiscs are the medium of choice for instruction which requires full-motion video sequences. However, the increasing use of Digital Video Interactive (DVI) technology will probably soon make the storage of full-motion video sequences on compact discs commonplace. Frequently, you can get away with fewer devices because they are not needed for all the lessons in a course. You may need one optical storage device for every CBT delivery station. Depending on how you manage instructional development, you may or may not require one for every development station. The key is that the most significant cost related to optional storage devices is in the initial manufacture of the disc. Once a disc has been mastered the costs of players is relatively minor. Costs associated with producing discs are in the development, pre- and -post-production, and mastering.

If you intend to purchase optical storage devices for your CBT system, check the box marked "Optical storage device" under Item 2 on Worksheet S. You should also note to the side how many and what type of optical storage devices you will need (e.g., one videodisc reader per station).

3. Input Devices

There are several types of input devices available. More than one type may be selected for use on a CBT station. This section will help you to decide which input devices you will need, and how many.

A. Keyboard. Keyboards are normally used for the entry of textual material, making choices from lettered or numbered lists, or moving through items with the direction keys. They are, of course, necessary for lesson development, but you may choose to have students interact with their lessons using some other input device, such as a light pen or touch screen. These alternative methods are often preferable if your students are unfamiliar with the use of the keyboard. The other input devices can also be much quicker than a keyboard for pointing at objects or words on the screen.

B. Joy stick. A joy stick is a device that allows its user to control movement and item selection (such as a target) on the screen. It can be an especially effective tool for development of eye-hand coordination or image manipulation tasks. However, a joy stick is not very accurate or fast for pointing to objects on the screen. To see if your instructional objectives require use of a joy stick, refer to question 97 on the Questionnaire. If the answer to this question is **Yes**, mark the block corresponding to "Joy stick" under Item 3 on Worksheet S.

C. Pointing devices. Pointing devices are a good substitute for the keyboard when you have students who can't type, or for other specific applications. They also make graphics development easier. To see if you will require pointing devices, refer to question 98 on the Questionnaire. If the answer to this question is **Yes**, some type of pointing device may be called for. Or, if Worksheets I and J indicate that development of high resolution graphics or animation is required, some type of pointing device would also be useful.

There are a variety of pointing devices which can be used; they can be interchanged to some degree, but there are also good reasons why you might choose one over another. These pointing devices are discussed in greater detail in the following paragraphs. After you read these paragraphs, mark the blocks corresponding to the types of pointing devices you will be using under "Pointing Devices," in Item 3 of Worksheet S.

Track ball. A track ball consists of a mounting, usually a box, in which is set a ball. As the user spins the ball, the cursor on the screen moves at the speed and in the direction of the ball's motion. Track balls are particularly helpful in teaching some radar operation type tasks, because some radar operators also use track balls on-the-job. Also, if table space is limited, a track ball is a good, precise input alternative. Frequently, a track ball is used in conjunction with the keyboard.

Light pen. Light pens are pen-shaped devices that the user can use to touch the screen to select certain pre-defined areas, e.g., to indicate various components on a picture

of a circuit board. Light pens are particularly appropriate for teaching users about equipment which they would not normally touch for safety reasons, such as moving parts in operational machinery or live electrical circuits. The light pen is very similar to an electronic technician's meter probe. One limitation of light pen use is fatigue. The user must lift his/her entire arm to point to objects on the screen. Student input becomes even more complex and difficult if the keyboard and light pen must be used simultaneously.

Touch screen. A touch screen is a type of monitor screen which allows users to respond to requests for input by touching certain pre-defined areas of the screen. Touch screens are particularly appropriate for teaching users control panel operation types of tasks, which require touching buttons or flipping switches. However, the accuracy of the touch screen is less precise than that of the light pen. Additionally, arm fatigue is a factor as with the light pen.

Mouse. A mouse is like a track ball, but the ball is on the bottom of the mouse, and housed in a box. As the user moves the box across a flat surface, the ball rotates, and the cursor moves correspondingly across the screen. Objects on the screen are selected by pressing one or more buttons on the top of the box. The chief advantage of a mouse is that it allows the user to move the cursor around the screen with great precision; it is a good pointing device to use when your requirements do not specifically suggest one of the others. A mouse can also be used for graphics development, and they are cheap and commonly available. This is usually the best choice for a pointing device. However, extra desk top space is required for the mouse pad.

Bitpad. A bitpad consists of a rectangular pad which can be connected to your computer and some type of drawing device (usually a special type of mouse or pen). It is used primarily for graphics development. The artist places a picture on the surface of the pad and traces the lines using the mouse or pen. As the lines are traced, the picture is reproduced on the screen. A bit pad is generally more cumbersome than a mouse, but it offers more precise tracing capabilities. Another reason to choose a bitpad over a mouse for graphics development would be if the software you use does not support use of a mouse.

D. Scanner. A scanner is an input device which can be used to transfer paper-based images into digital form for presentation on the screen. It is particularly useful if your instruction requires extensive use of high definition graphics or video stills (e.g., photographs); if these images already exist, the scanner can easily digitize them for presentation on the computer.

Good scanners do their work quickly, and are expensive, so it's preferable to share them if feasible. You will probably only need one scanner for every location where graphics development occurs.

Refer to Worksheets I and L. If a requirement for graphics or video stills is indicated, a scanner may be needed. Enter check mark in the blank corresponding to "Scanner" under Item 3 on Worksheet S. Also note how many scanners you will need (normally no more than one).

E. Microphone. If audio support is required, and this support is to include some level of interpretation of a student's oral response (as evidenced by Worksheet K, "Audio Support Requirements"), then a microphone will be required.

You should have one microphone for every CBT delivery station. Depending on how you manage instructional development, you may or may not require one for every development station.

If your requirements indicate a need for microphones, enter a check mark beside the blank marked "Microphone" under Item 3 of Worksheet S. Also note how many microphones you will need.

4. Output devices

There are also many types of output devices available for your system. Those covered here are ones most common to CBT systems. They include: 1) monitors; 2) printers; and 3) speakers. The purpose of this section is to help you to decide how many and what type of output devices you will need.

A. Monitors. A monitor is a device which looks like a television set, but has no channel selector. It receives its picture signal from a video display adaptor, which is a circuit board inserted inside the computer. All microcomputer systems include both a monitor and a video display adaptor. Although the monitor is the more visible member of the set, the quality of video output is actually determined by both the monitor and the video display adaptor. This section is intended to help you to identify the monitor/video display adaptor combination most suited to your instructional requirements.

There are two issues to consider when selecting monitors and video display adapters: 1) the color of the output, and 2) the clarity, or resolution, or the output. The color and clarity of the output is a function of the monitor and the graphics board. Generally speaking, there are three types of monitors:

Monochrome. This type of monitor displays a single color (usually white, amber, or green) on a contrasting background (usually black). Usually some gradients (i.e., shades) of color can be displayed, but these are usually quite limited.

Color. As the name suggests, a color monitor is a monitor that can display a variety of different colors.

Gray tone. A gray tone monitor is like a monochrome monitor, but is able to utilize variations in brightness level (usually 64 shades) to enhance the contrast among various elements on the screen.

There are also, generally speaking, three types of video display adapters with which you will normally be dealing:

Monochrome. A monochrome board generates a one-color signal. The color of the signal depends on the monitor. The resolution (i.e., clarity) of the resulting video image is considered to be high.

Enhanced Graphics Adaptor (EGA). Most EGA boards can display up to 16 colors on the screen simultaneously, and offer up to 64 shades of color. The resolution is also high, although monochrome boards are usually marginally higher.

Video Graphics Array (VGA). VGA boards allow you to display as many as 256 colors on the screen simultaneously, and offer up to 262,144 shades of color; but with this range of colors, the resolution is only moderate. A high level of resolution (even higher than that of monochrome boards) can be achieved by reducing the number of colors that can be shown on the screen simultaneously to 16.

To select a monitor/video display adaptor combination, consider your instructional needs. Refer to Worksheets I ("Graphic Support Requirements"), J ("Animation Support Requirements"), and L ("Video Support Requirements"). If your instruction does not require the use of color at all, a monochrome monitor/monochrome card or a gray tone monitor/monochrome card combination should be sufficient for your needs. If the use of color is required, then you should select either a color monitor/EGA card or a color monitor/VGA card combination, depending on your color and resolution requirements.

Place a check mark beside the types of monitor and video display adapters you choose under Item 4 on Worksheet S. You should also list how many of each that you will require; it is suggested that you utilize the same monitor/video display adaptor combination for all your CBT stations, both development and delivery.

B. Printers. A printer is an output device that produces hardcopy output. There are essentially three types of printers available to select from: 1) near letter quality; 2) letter quality; and 3) color. The basic capabilities of these printers are described in Table S-2 on the following page.

Printers are essential during the lesson development process, so that developers may obtain hard copies of their work. Whether or not students and instructors require access to printers depends on your instructional and report generation requirements. If you are utilizing stand-alone microcomputers, it is recommended that, at a minimum, you obtain

printers for each of your development stations; in addition, if you need to print out reports, you should obtain at least one printer per classroom at your delivery sites. If you are utilizing networked microcomputers, you should obtain approximately one printer for every ten developers who are likely to be using the same system at once; and at least one printer per classroom at your delivery sites.

To select a printer, refer to Worksheets I ("Graphics Support Requirements"), J ("Animation Support Requirements") and L ("Video Support Requirements") and to questions 69, 75, 85 and 86. Indicate the type of printer support your system will require by checking the appropriate box under the heading "Printer" under Item 4 on Worksheet S. Also note how many of each type of printer you will require.

Printer	Description
Near Letter Quality	Usually can perform in two modes: near letter quality and draft. The printer can produce more characters per second (cps) in draft mode than in near letter quality mode. Some near letter quality printers support different type faces or fonts, and most will also print graphics. In general, the printer is quick, requires low maintenance and is inexpensive to operate, particularly for large volume printing. Some examples include: 9-pin dot matrix printers, 24-pin dot matrix printers and thermal printers.
Letter Quality	Letter quality printers generally have print quality that is high to very high. The speed of letter quality printers can range from two pages per minute to more than 50, depending upon the printer and how the images are produced. There are essentially four types of letter quality printers: (1) impact or daisy wheel printers where the image is produced by a key striking a carbon ribbon; (2) ink jet printers where the image is produced by spraying a jet of ink onto the paper; (3) laser jet printers in which the image is created much like a photocopy; and (4) plotter printers where the characters or images are drawn on the paper. The ink jet, laser jet and plotter will support fonts and graphics. Maintenance and production costs run from low (impact printer) to high (ink jet, laser printer, plotter). Excellent printer for final copy and high definition print requirements.
Color	Color printing can be supported by dot matrix printers, thermal printers, ink jet printers and laser printers. Page production speed is heavily dependent upon the mechanics of image creation, but is comparable to the standards mentioned above. The production and maintenance costs are also dependent upon the underlying technology and are analogous to the information presented above. Dot matrix color printers rely on color ribbons to produce the images. The others mentioned rely on colored ink or toner and can require special paper, as well. Each of these printers will support fonts and graphics development.

TABLE S-2

C. Speakers. If Worksheet K indicates a requirement for audio support, you should complete this section; otherwise, you may proceed to the Interpretation section of this decision.

There are three types of speakers that can be used to provide audio support: 1) built-in speakers; 2) external speakers; and 3) headphones or headsets. Built-in speakers refer to speakers which are built-in to the monitor. Although this feature is convenient in that it reduces the amount of equipment you need to inventory and maintain, it can drive up the cost of the monitor. External speakers are speakers which are connected to the computer, and are like conventional stereo speakers; they generally produce higher quality sound than built-in speakers. Headphones and headsets are speakers which can be worn over an individual's ears.

The decision to utilize one type of speaker or another depends in part on the training requirements and in part on the type of classroom environment the audio will be presented in. For example, if several students will be taking different audio-supported lessons in the same room at the same time, headphones would be advisable. However, if the instruction is presented to one student at a time, built-in or external speakers can be used. The decision to use built-in or external speakers should be based on a comparison of cost and ability to achieve the desired sound quality. If you are going to utilize speakers as part of your CBT system, they should help replicate the job environment as much as possible. If your students normally respond to sound which they receive over speakers, then either external or built-in speakers would be appropriate. If the student normally receives the signals over headphones, or via telephone, you should consider fabricating a device which is similar for your CBT system.

Enter your speaker selection on the worksheet by marking the appropriate blocks under "Speaker," for Item 4 on Worksheet S. You should also list how many of each type of speaker that you will require; for simplicity's sake, it is suggested that you utilize the same speaker configuration for all your CBT stations, both development and delivery.

DECISION S
Equipment Requirements

1. Computer — Type — Quantity

   [ ] A. Mainframe _____

   [ ] B. Minicomputer _____

   [ ] C. Networked microcomputers _____

   [ ] D. Stand-alone microcomputers _____

2. Storage Devices

   Required Storage Capacity _____

   [ ] A. Floppy disk drive _____

   [ ] B. Hard disk _____

   [ ] C. Tape drive _____

   [ ] D. Optical storage devices _____

3. Input Devices

   [ ] A. Keyboard _____

   [ ] B. Joystick [97] _____

   C. Pointing device [98] _____

   [ ] Track ball _____

   [ ] Light pen _____

   [ ] Touch screen _____

   [ ] Mouse _____

   [ ] Bitpad _____

   [ ] D. Scanner _____

   [ ] E. Microphone _____

4. Output Devices	Type	Quantity
A. Monitor/Video Display Adaptor Combination		
Monitor		
[ ] Monochrome		
[ ] Color		
[ ] Graytone		
[ ] Video Display Adaptor		
[ ] Monochrome		
[ ] EGA		
[ ] VGA		
B. Printer		
[ ] Near letter quality		
[ ] Letter quality		
[ ] Color		
C. Speaker		
[ ] Built-in		
[ ] External		
[ ] Headphone		

DECISION S
Equipment Required

Interpretation

You should be able to use the information from Worksheet S, together with Worksheets P, Q and R, to develop the hardware requirements portion of a CBT systems specification. In either case, you should work closely with a computer systems analyst to determine precisely what equipment to purchase and how to configure it. If you plan to utilize existing equipment (see Decision T), you may also wish to compare this list with what you already have.

A word of caution: often, government organizations commit themselves to purchasing specific equipment for CBT before they are ready to actually start programming lesson material. By the time they begin outlining and storyboarding lessons, better systems and equipment have entered the market--but they're stuck with the old equipment. Although much of this problem is due to the nature of the acquisitions process and can't be avoided, the effects may be alleviated somewhat if your organization can: 1) reasonably estimate lesson development time; 2) anticipate the lead time between purchase and delivery of equipment, and delay equipment purchase as long as feasible; and 3) stay informed about new hardware (and software) developments.

DECISION T
System Component Compatibility

Compatibility between the various components of your CBT system is crucial to success. If any of the components are not designed to support one another or to work together, system operation, and in all probablility, training, will suffer. The purpose of the worksheets in this section is to provide you with an organized listing of existing equipment and software that will be used with the proposed system. Worksheet T.1 will help you to specify what software will need to be integrated with your proposed CBT system; Worksheet T.2 does the same for hardware. The Interpretation section of this decision will help you to consider some of the compatibility issues related to the incorporation of new equipment with existing equipment. If your plans don't include using existing capabilities, you may skip the worksheet; however, the principle of compatibility as described in the Interpretation section should be reviewed because this issue is pertinent to all system component decisions.

Worksheet T.1 Instructions

1. Refer to question 46 on the Questionnaire. If software programs currently in use will be used with the proposed CBT system, mark the boxes corresponding to the software to be used under Item 1 on Worksheet T.1. Also gather the information needed to complete the right side of this section; "Description" and "Version No." refer to the brand or publisher of the package and its version number the intended for use with the new system, e.g., Word Perfect 5.1, Lotus 1-2-3 Version 3.0, PC Paintbrush 4.0+, etc. This information will be necessary to determine if it's compatible with any new software which you might acquire.

2. Refer to question 102 and 107 on the Questionnaire. If the answer to either of these questions is Yes, mark the block corresponding to "Input from other systems" under Item 2; and describe the software packages from which CMI data is to be transferred.

Worksheet T.2 Instructions

Use this worksheet only if you plan to use existing computer equipment with your proposed CBT system. Essentially, this worksheet is identical in format to Worksheet S.

1. Refer to question 45. Check off the type of existing equipment which you plan to use on the left, and describe it in detail (i.e., brand name, how many you have) on the lines to the right of each item.

2. After completing Worksheet T.2, "Existing Computing Equipment to be Used," compare it to Worksheet S, "Equipment Required." By comparing the list of equipment you already have with the list of what you will need, you will be able to identify the type and amount of additional equipment, if any, which needs to be purchased.

3. Revise Worksheet S to reflect the equipment which you will need to acquire in addition to the equipment listed on Worksheet T.2. Annotate each change clearly so that you will clearly identify whatever remains to be acquired.

DECISION T
Compatibility

Existing Software and CMI Data

1. Existing Software [46]

Type	Description	Version No.
[ ] a. Authoring system		
[ ] b. Courseware delivery		
[ ] c. Graphics Package		
[ ] d. Animation package		
[ ] e. Word processing		
[ ] f. Spreadsheet		
[ ] g. Data Base		
[ ] h. Flow chart package		
[ ] i. Statistical package		
[ ] j. Utility package		
[ ] k. Other		

2. CMI Data [102, 107]

Input from other systems ..... [ ]

Description	Version No.

DECISION T
Compatibility

Existing Computer Equipment to be Used

1. Computer — Type — Quantity

   [ ] A. Mainframe _____

   [ ] B. Minicomputer _____

   [ ] C. Networked microcomputers _____

   [ ] D. Stand-alone microcomputers _____

2. Storage Devices

   [ ] A. Floppy disk drive _____ _____

   [ ] B. Hard disk _____

   [ ] C. Tape drive _____

   [ ] D. Optical storage devices _____

3. Input Devices

   [ ] A. Keyboard _____

   [ ] B. Joystick _____

   C. Pointing device _____

   [ ] Track ball _____

   [ ] Light pen _____

   [ ] Touch screen _____

   [ ] Mouse _____

   [ ] Bitpad _____

   [ ] D. Scanner _____

   [ ] E. Microphone _____

4. Output Devices	Type	Quantity
A. Monitor/Video Display Adaptor Combination		
Monitor		
[ ] Monochrome	_____	
[ ] Color	_____	
[ ] Graytone	_____	
[ ] Video Display Adaptor	_____	
[ ] Monochrome	_____	
[ ] EGA	_____	
[ ] VGA	_____	
B. Printer		
[ ] Near letter quality	_____	
[ ] Letter quality	_____	
[ ] Color	_____	
C. Speaker		
[ ] Built-in	_____	
[ ] External	_____	
[ ] Headphone	_____	

DECISION T
System Component Compatibility

Interpretation

As you probably know, not all hardware components will work with all computers or with each other. The same is true for software. Software requires a specific operating system environment in order to function properly. Files created with one package may not be exportable to another without some level of conversion or, at times, this may not be possible at all. Many hardware and software components make up a CBT system. If any one part of the system is incompatible, the system will not operate as expected and time consuming delays and user frustration will undoubtedly follow.

After the worksheet information has been compiled, it should be compared to Worksheet S "Equipment Required." The existing equipment should be investigated fully before a final decision is made to utilize it in the proposed CBT system. Failure to address compatibility issues can be fatal to the success of CBT implementation just as with any other computer system. When finalizing the hardware and software decisions that must be made, do not rely solely on the documentation that accompanies these components, as compatibility issues are not always addressed sufficiently. It is strongly recommended that you consult with a computer systems analyst, and hardware and software vendors before making any purchases.

DECISION U
Capacity to Upgrade System

The purpose of this decision is to help you to anticipate ways in which your training system may need "room to grow" in the future. If room for growth or expansion of a technology can be built into a system at the front end of a project, considerable time and money may be saved. When you completed Decisions A and E, you were asked to consider changes in the training system requirements which might affect the decision to implement CBT for a particular objective and the decision as to how the related instructional material should be presented. Now that some preliminary CBT equipment decisions have been made, you should consider what impact change could have on the hardware and software components of your system.

Change can have a potentially disastrous effect on a training system. If the CBT system planners do not take into account such factors as differing student loads, the experience or prior training level of students, or the need for maintenance of both software and hardware, it could lead to the need for very costly upgrades to the CBT system. When considering your current training requirements, keep in mind that a change in training media such as from your current principal training medium to CBT affects nearly all the components of the training system. Current objectives were usually not prepared with CBT in mind, and will probably require some revision to implement the new technology. Instructors and administrators who have grown accustomed to collecting and calculating various student management data manually, must be prepared to shift from performing the collection and calculation functions to utilizing the results provided by a CMI system to improve student performance. The introduction of a new medium into a training system always has some effect. The introduction of such a different medium as CBT has very pronounced effects. The faculty must be prepared to allow students to progress through the curriculum at their own pace. They must learn to recognize those signs which indicate that a student does not understand a lesson rather than the rate at which the student progresses through some lessons. All of these factors related to CBT provide the potential for change. When planning the CBT system, you should be as "far-thinking" as possible in trying to describe and plan for a CBT system which will suit your current and future needs.

Review some of the decisions which you have already made regarding your CBT system with change in mind. If any of these decisions no longer fit, you should change them to reflect what you think will be required. Be sure to annotate any revisions on the appropriate worksheet and make note of the rationale for changing it.

As you complete Worksheet U, you should have Worksheets A, C, E.1, and Q available for reference.

Instructions

1. Computer requirements can be impacted by a number of factors, some of which are listed below. Please review the worksheets which you previously completed [referenced in brackets], and evaluate the likelihood of changes to the information recorded on them.

   a. Substantial changes to course objectives [Worksheet A]. Changes to course objectives could potentially impact the required computing capability of your CBT system. Review Worksheet A again to determine if you have realistically represented the training requirements.

   b. Dramatic increase or decrease in the number of students using CBT at any one time [Worksheet C]. Substantial changes in the number of students using CBT at any one time may affect the number of stations required; the system configuration; and, if you use a networked system, your required computing capability. Review Worksheet C to determine if the level of student activity described there needs to be adjusted.

   c. Changes in the type of CBT technology used [Worksheet E.1]. Simulations, for example, often require substantial computing capability to run at an acceptable speed. An increase or decrease in the use of simulation could have a dramatic effect on the required amount of computing capability. Review Worksheet E.1 to determine if the various kinds of support indicated there are realistic or need to be adjusted.

   d. Changes in communication and/or sharing requirements [Worksheet Q]. Changes to requirements to communicate or share data within a class, within a school, or across geographical locations could impact both required computing capability and system configuration.

   Based on Worksheets A, C, E.1, and Q, the changes you anticipate, and the information above, indicate how computer requirements may be impacted, if at all, under Item 1 on Worksheet U.

2. Storage device requirements can also be impacted by a number of factors, which are listed below. Follow the same procedure as you did for item 1 above.

   a. Dramatic increase or decrease in the number of students using the CBT system [Worksheet C]. This could increase the number of student records you need to maintain, which would in turn increase your required storage capacity. Review Worksheet C again to ensure that the level of student activity described there is accurate for current and future operations.

b. Changes in the type of CBT technology used [Worksheet E.1]. For example, if you decide later to incorporate video into your training, you will have to acquire some type of optical storage device, such as a videodisc player. This would impact the type of storage device needed. Review Worksheet E.1 to determine if the various kinds of support indicated there are realistic or need to be adjusted.

c. Increase or decrease in the amount of software (e.g., applications software or courseware) on the system. This is particularly likely to happen if your equipment is used for other applications in addition to CBT. This could impact your system's required storage capacity.

Based on Worksheets C and E.1, the changes you anticipate, and the information above, indicate how storage device requirements may be impacted, if at all, under Item 2 on Worksheet U.

3. Some factors which could impact input device requirements are listed below. Follow the same procedures as above.

a. Dramatic increase or decrease in the number of students using the CBT system [Worksheet C]. This could impact the number of input devices you require. Your review of Worksheet C should indicate changes.

b. Changes in the type of CBT technology used [Worksheet E.1]. For example, more extensive use of graphics could necessitate the use of a mouse or bitpad for graphics development. More extensive use of simulation may require use of a light pen or touch screen. In other words, a change in the type of CBT technology used could affect the type of input devices required for your CBT system. Your review of Worksheet E.1 should be reflected here.

Based on Worksheets C and E.1, the changes you anticipate, and the information above, indicate how input device requirements may be impacted, if at all, under Item 3 on Worksheet U.

4. Some factors which could impact output device requirements are listed below. Follow the same procedure as before.

a. Dramatic increase or decrease in the number of students using the CBT system [Worksheet C]. Again, this could impact the number of output devices you require.

b. Changes in the type of CBT technology used [Worksheet E.1]. For example, the addition of audio could necessitate the purchase of speakers. Or, extensive use of graphics or simulations might require the use of color monitors. These are the

types of changes which could affect the type of output devices required by your CBT system.

Based on Worksheets C and E.1, the changes you anticipate, and the information above, indicate how output device requirements may be impacted, if at all, under Item 4 on Worksheet U.

5. Review the information that you have recorded on Worksheet U. If you have anticipated changes in any particular area, elaborate on those changes in the space to the right. For example, if you have indicated that there may be a change in the number of stations needed, state whether it would be an increase or a decrease, and estimate how many stations would be needed. Or, if a change in the type of input devices needed is indicated, you should write what type is anticipated. Annotate Worksheet S to reflect the new equipment requirements.

WORKSHEET U
Capacity to Upgrade System

1. Changes in Computer Requirements

   [ ] No changes anticipated.

   [ ] Changes anticipated. May impact:

      [ ] Number of stations needed

      [ ] Computing capability needed

      [ ] System configuration

      [ ] Other_____

2. Changes in Storage Device Requirements

   [ ] No change.

   [ ] Changes anticipated. May impact:

      [ ] Amount of required storage capacity

      [ ] Types of storage devices needed

      [ ] Other_____

3. Changes in Input Device Requirements

   [ ] No change

   [ ] Changes anticipated. May impact:

      [ ] Number of input devices needed

      [ ] Types of input devices needed

      [ ] Other_____

4. Changes in Output Device Requirements

[ ] No change.

[ ] Changes anticipated. May impact:

[ ] Number of output devices needed

[ ] Types of output devices needed

[ ] Other_____

DECISION U
Capacity to Upgrade System

Interpretation

The information from the four sections in Worksheet U should be compared with the information from the corresponding sections on Worksheet S, "Equipment Required." You should revise your conclusions on Worksheet S based on the information about anticipated changes in Worksheet U, or you may choose to delay acting upon the anticipated changes until they actually happen. In any case, in purchasing any of the equipment listed on Worksheet S, you should keep in mind anticipated changes to the system, and make sure that equipment you will want in the future is compatible with equipment you are purchasing now.

In general, it is usually a good rule of thumb to purchase as much computing power and storage capacity as you can afford. This normally delays the obsolescence of a computerized system for a longer time. Although no one can guarantee that the system you buy today will not be superseded by a better system tomorrow, we know that systems on the more powerful end of the spectrum tend to last longer.

DECISION V
Equipment Maintenance

Often, there are significant equipment differences between conventional instructional settings and computer-based training environments. One of the factors which must be taken into account in implementing CBT is equipment maintenanc e. While an organization's equipment maintenance capability may be adequate to support the conventional setting, the "capability picture" could easily change with the introduction of CBT technology. As used here, "capability" refers to the maintenance staff's technical ability and its availability to perform the work required to meet the minimum operational readiness commitment. Whether the work will be performed by in-house maintenance staff or by a maintenance contract, an assessment must be completed. Worksheet V serves to help identify the additional staff training/experience and numbers needed for in-house support of projected equipment maintenance due to the introduction of CBT. It also aids in identifying specific requirements for a new maintenance agreement or the modification of an existing agreement to meet the changes brought about by CBT. In other words, for the in-house staff, the decision maker must view the changed equipment maintenance requirements in light of actual staff capability to perform the work. For contract maintenance, the decision maker must view the changed equipment requirements in light of the current contract specification.

Complete Worksheet V according to the instructions provided below. Upon completion of the Worksheet, you should consult the section titled **Interpretation** for further explanation of each item and your responses. Remember, only a portion of the Worksheet may apply to your organization or mission; in that instance, you should complete only those portions that apply.

Instructions

1. Refer to question 120 on the Questionnaire. If you answered **Yes** to this question you will need to assess the need to continue or modify this contract once you have implemented CBT. Review and compare the current equipment maintenance agreement and the projected requirements in terms of equipment type, quantity, and frequency of required maintenance. List the equipment needed for an implemented CBT environment (from Decision S) by type, quantity, and frequency of required maintenance in the spaces provided. (Note that the list may contain both current and projected equipment, as applicable). You may have to go through the same decision process as is needed to determine in-house maintenance capability in order to develop the details for a modification to your existing equipment maintenance contract or to determine what you will need in a new contract. (See 2 below.)

2. Refer to Worksheet D. Review your organization's current capability to maintain CBT equipment. You should look at the type of CBT equipment you will be using (refer to Worksheet S), the experience and/or training which you staff has in maintaining this type

of equipment, and the availability of these same personnel to perform the maintenance.

a) Using Worksheet S, list on Worksheet V the CBT equipment which will need maintenance.

b) In the "Requirement" column list the approximate man-years of maintenance support needed annually. Refer to the interpretation section for specific calculations.

c) Total the "Requirement" column.

d) In the "Staff Available" column list the approximate man-years of maintenance support which is available to your organization. Refer to Worksheet D on the Questionnaire. You should only list that portion of the man-years as available which directly reflects the organization's maintenance capability.

e) In the "Staff Experience" column list the number of personnel who are experienced or trained in maintaining CBT equipment.

f) By comparing the "Staff Available" to the "Staff Experience" column you will be able to determine whether or not your organization is able to perform CBT equipment maintenance with current staff, how much training you will need to bring the staff up to the level required, and how many additional staff may be required.

3. The final step in the process is to determine which specific equipment your staff is able to maintain and which it is not able to maintain. This will require a closer look at your staff's maintenance capabilities. For each item which you "Cannot Maintain" place a checkmark in that column. These are items for which you will need a maintenance contract.

DECISION V
Equipment Maintenance

		Type	Quantity	Requirement	Staff Available	Staff Experience	Cannot Maintain
1.	Computer						
	A. Mainframe						
	B. Minicomputer						
	C. Networked minicomputers						
	D. Stand-alone microcomputers						
2.	Storage Devices						
	Required Storage Capacity						
	A. Floppy Disk drive						
	B. Hard disk						
	C. Tape drive						
	D. Optical storage devices						
3.	Input Devices						
	A. Keyboard						
	B. Joystick [109]						
	C. Pointing device [110]						
	D. Track ball						
	E. Light pen						
	F. Touch screen						
	G. Mouse						

	Type	Quantity	Requirement	Staff Available	Staff Experience	Cannot Maintain
H. Bitpad						
I. Scanner						
J. Microphone						
4. Printers						
A. Laser						
B. Dot Matrix						

(Requirement total) _____

DECISION V
Equipment Maintenance

Interpretation

This section is designed to help you in identifying most of your maintenance requirements, and in determining if any changes are warranted or needed based on the introduction of CBT. Whether you perform the maintenance in-house or by means of a maintenance contract, this worksheet will be useful in cataloging any required changes.

Contracted Equipment Maintenance

If you are currently using a contractor to perform equipment maintenance, you will probably want to review that contract to determine:

1) If it can be terminated because the need for the equipment which is being maintained will be eliminated when CBT is implemented.

2) Whether the contract should be continued. Once you have determined that the equipment which is being maintained by contract will continue to be used after the implementation of CBT, you will further need to determine how much of it will continue to need maintenance.

3) Whether you can/should add to the contract to cover the CBT equipment maintenance requirement.

If you are not replacing all instruction with CBT you will probably need to retain some of the same equipment which you had prior to CBT implementation.

The existing contract may be able to be modified so that you can reduce (or increase) the amount of support contracted for. You should count on several weeks to months for this process to make it through the contracting office. Two points should also be mentioned: First, companies which maintain instructional equipment are not necessarily prepared to maintain computer equipment (there are exceptions). These companies tend to focus on the "low-tech" end of the spectrum. You will probably need to look elsewhere for CBT equipment maintenance support. Your contracting officer can usually be of help in providing lists of such maintenance contractors. Second, most of the computer equipment which the government buys comes already bundled with maintenance or has a very low cost maintenance option. These options should be explored first, before acquiring CBT equipment maintenance which may be duplications. If you do not purchase your CBT equipment from an existing government contract, you should ask the vendor to provide you with several maintenance options so that you can determine which is the most suitable and cost effective for your organization. You should be ready to pay up to 10% of the purchase price of the equipment or software annually for a maintenance agreement. Obviously,

the more equipment you plan to purchase, the more leverage you will have in negotiating a more favorable maintenance agreement.

In-House Equipment Maintenance

If you already perform maintenance on computer equipment in-house, you will probably have little trouble maintaining the computer equipment used for CBT. Some specific items such as light-pens, joysticks, touch screens, optical disc players, etc., may require that you get a maintenance contract or send your technicians to school to learn how to repair them. Weigh carefully the costs and benefits associated with attempting to maintain such devices. It is invariably far less costly and troublesome to buy vendor maintenance than to train organizational personnel.

Be cautious when determining that you can maintain the CBT equipment in-house. Although your staff may be fully trained and capable of maintaining the equipment, a significant increase in maintenance requirements may overload your existing staff. To calculate the number of man-years of maintenance required for each item, you should use the following as very broad guidelines:

Mainframe:	See specific vendors for details
Minicomputer:	See specific vendors for details
Microcomputers:	1 man-day/year/computer
Networks:	15 man-days/year/network

[Note: These guidelines have not been developed as a result of extensive research, but will provide some basis for estimating maintenance.]

Most input devices and other such peripheral equipment involve such little maintenance, or are of such small numbers, that the time for maintenance is negligible unless there are high numbers of these devices involved. Maintenance of hard disks is something which is best left to the specialists.

DECISION W
Facility Change Requirements

Deciding whether implementing CBT will necessitate changes to current facilities depends on several factors. Major among these are: 1) the type and amount of needed hardware; 2) the required number of student workstations; and 3) the degree of security necessary to ensure adequate protection. These factors are further detailed in the following paragraphs and will serve as a guide toward decision making. There is no worksheet for this decision.

Facility Size Considerations

The facility size and layout can influence the size and design layout of a CBT system, and conversely, the size and design of a CBT system can have a dramatic effect on an organization's training facilities. The availability of proper facilities can either hinder or enhance the implementation of CBT and day-to-day instructional operation. The expense associated with modifying facilities in order to take advantage of the most economical system design may not be practical. Decision makers must weigh these carefully and examine the various facilities and CBT configuration possibilities available.

Required space is usually the first consideration. The space needed to accommodate students in a conventional instructional setting may or may not suffice for a CBT system. Because of the slightly increased student work area normally needed for CBT, the overall space requirement tends to exceed a conventional arrangement. As a rule of thumb in calculating the total required workstation space, the number of required workstations may be multiplied times 35 sq. ft. per station. This rate minimally allows for actual student equipment and work space, aisle space for safe student passage, and space needed for equipment and network cabling.

Electrical Power

Determining power requirements depends upon several factors including the number of rooms, the amount of equipment, and the arrangement of furniture. Generally speaking, a single 20 amp circuit can adequately handle the power required for the simultaneous operation of 5 or 6 microcomputers. Additional power may be required if a CBT classroom or laboratory is configured with more than that number. Power requirements should be calculated as follows:

1. Use an average of 3.5 to 4 amps per station of computer equipment (e.g.,microcomputer, IVD player, monitor, printer, file server, etc.) when figuring power requirements. Normally a monitor and computer together draw about 3.5 amps.

2. It will be necessary to determine the number of circuits needed per room (classroom or laboratory) in which computer equipment is planned for installation. Under normal circumstances, a single 20 amp circuit supplies power to between 3 to 5 rooms. Remember, however, that only 5 or 6 pieces of computer equipment may be serviced by

a single 20 amp circuit. Whether a single 20 amp circuit serves the power needs of a single room or multiple rooms, no more than 5 or 6 pieces of equipment may be used on that circuit. If you desire more equipment than that to be installed and used in an area serviced by a 20 amp circuit, more power (greater amperage) or additional circuits will be required and an electrician should be consulted.

3. Determine the number of pieces of computer equipment that will be used in a given classroom or laboratory. For example:

Student Stations	12
Instructor Stations	1
File Server	1
Printer	1
TOTAL	15

4. Determine the number of circuits required per room by multiplying the total number of pieces of equipment for a given room (e.g., 15) times the average number of amps per piece (3.5). Round up the resulting number to the nearest number easily divisible by 20. That rounded number represents the total power required for the room. Divide the total power requirement by 20. This will give you the number of circuits needed for the room. For example:

15 x 3.5 = 52.5 (amps needed)
52.5 rounded up = 60
60 divided by 20 = 3
3 = number required circuits

You can now estimate how much electrical rework is needed to install and operate the CBT equipment. The examples given above referred to the 20 amp circuit because it is most commonly used. However, some locations may use circuits with ratings of 30 or more. For the purpose of determining the number of circuits needed per room, 20 amps may be substituted by another appropriate amperage in the formula. Consult your base engineers if you are not sure.

Mini and Mainframe Computers

If the use of a mini or mainframe computer is planned and you don't already have one installed, some special provisions may be necessary. As a rule, minicomputers do not require special accommodations other than normal room ventilation and temperature. However, a desired minimum of space for the minicomputer may be calculated as follows: Multiply the length and width of the computer to get the square footage (footprint). Multiply the "footprint" times 8. Again, this rate allows minimal space for equipment ventilation and access. Each manufacturer will specify the environmental requirements of their computers, so consult the vendors for details.

Unlike minicomputers or PCs, a mainframe computer generally requires special environmental conditions, due primarily to its sensitivity to the elements and the sheer cost of repair and replacement. These special needs are normally specified by the computer manufacturer. Using a mainframe computer even on a shared basis today is an option very rarely elected. Considering the computing power of today's smaller computers and the advantages derived through various CBT system architectural designs, the need for a mainframe computer is difficult to justify for CBT alone.

Physical facilities, in general, require a certain amount of protection from unauthorized access or intrusion. This degree of protection directly relates to the sensitivity or value of material and/or equipment requiring protection. As the facility planner, you should consult appropriate regulations for guidance on security matters and requirements for safeguarding the contents of the facility.

DECISION X
CBT Affordability

Up to this point, the amount and type of CBT-related resources (hardware, software, development/maintenance personnel, and facilities) have been defined based on actual or perceived training mission needs. The question of affordability can only be answered by considering together three major factors: (1) Incremental and total costs of required resources, (2) timetable for acquiring required resources and implementing the CBT system, and (3) amount and timeframe of available funding. Each of these factors carry equal importance in the planning, selection and implementation process, as they are interdependent. As a decision maker, you must strike an acceptable balance among these three factors. Worksheet X will assist you in this process by providing a structured means of looking at and analyzing the information needed to make such an important decision. Remember, some of the information needed to complete this worksheet may not be immediately available, and some parts may have to be completed later when the information becomes available.

Complete Worksheet X according to the instructions provided below. Upon completion of these items, you should consult the section titled **Interpretation** for a more detailed explanation of each item and the responses.

Instructions

1. Calculate the equipment costs for the number of CBT stations and additional instructor and courseware maintenance stations required. Refer to Worksheet P. Enter the total number of stations required on line 1. (This worksheet assumes that you will be using microcomputers. For minicomputers or mainframes, please consult your base computer support specialist). Multiply the number of terminals by $2,500 – $5,000. This will give a rough estimate of hardware costs. [Note: Use the higher figure if you are considering using IVD, touch screen or special devices. Use the lower figure if you are considering a traditional CBT configuration].

2. Calculate the software costs for the number of CBT stations. The best method for calculating CBT software costs is to contact the individual CBT authoring system vendor to get the latest price list for single station delivery, authoring, and multiple station or network delivery. There are some vendors who will provide a single price for a site license which allows you to deliver CBT on as many terminals as you wish as long as it's within your organization. In general, unless you are acquiring an elaborate system, CBT software should be in the range of $25,000 for several authoring stations and delivery on up to 20 single or networked stations.

3. The biggest cost driver for the acquisition of a CBT system is the instructional development costs. You can estimate these by multiplying the total number of CBT hours

from Worksheet B times the cost of developing one hour of CBT (approximately $5,000 - $10,000). If your CBT is relatively straightforward, with no sophisticated graphics or IVD/DVI requirements, select a figure near the lower end of this range ($5,000). If your requirements are more elaborate, with detailed simulation or IVD/DVI, select a figure near the upper end of this scale ($10,000). The result will give you the approximate costs to develop your CBT. Remember, this will give you a rough order of magnitude cost. The costs can vary widely based on numerous factors. Don't expect a contractor to bid exactly what you have estimated here. Use these figures to "get in the ball park."

4. If facility modifications are required, you will need to get a cost estimate of these changes to buildings, electricity, etc. Enter the cost on line 4.

5. You can calculate the maintenance costs of the CBT hardware, software and courseware by using a factor of .05. Multiply the total hardware, software and courseware costs (Items 1-3) by this factor. The result is an approximate annual maintenance cost for the "out-years" of your system.

6. If you expect your system to last 10 years, you should multiply the maintenance costs by the number of years (10) it is expected to last. This number provides you with the overall maintenance cost. Remember that this figure is calculated in current year dollars. You may need to inflate this figure based on out-year dollar equivalents. Also, you need this money over the life-cycle of the system, not all up-front.

7. Total lines 1, 2, 3, 4, and 6. This is the approximate total CBT system cost.

8. For each of the five categories (equipment, software, instructional development, facilities modification, and system maintenance), estimate the costs per fiscal year (FY) in which funding will be required. Distribute the various category costs on the sheet over the time period allotted for funding and acquisition according to need. For example, the various types and amounts of equipment may be needed at different times. Your plans may include installing a total of 35 workstations during a given fiscal year. You may decide to install 15 to begin with and install the remainder at a later time. If you purchase all 35 at once, the problem you may face is having to locate a place to store the other 20 stations for possibly several months. You may decide to phase the procurement to meet your installation plans. In other words, you may wish to purchase and install 15 student stations during the first fiscal year and purchase the remaining 20 at a more appropriate, later date. Using this example, you would determine the cost of 15 workstations and enter that cost on the worksheet under the column headed "1st FY___." Next, determine the cost of the remaining 20 stations, and enter that amount on the worksheet for the year in which you wish to purchase those stations. Consider the desired purchase and implementation time for each category (e.g., equipment, software, instructional development, facility modification, system maintenance, etc.). As with the above equipment example, determine the costs for each category and amount and enter it on the worksheet for the appropriate quarter. Once all the costs have been entered on the

worksheet, sum the costs within each column and enter the subtotals for each in the applicable spaces. This provides a year by year cost estimate.

9. From each FY column provided in the above (Item 8), transfer the subtotals to the corresponding lines in Column A Item 9. Sum the entries (Column A) for all FYs and enter the result as a grand total. The entries and total amount in Column A represent a summary of your planned funds requirement for four FYs. You will use this to request funding for the different FYs and for the various amounts shown there. Your goal is to receive approved funding according to that plan. When known, enter the approved funding amounts for each FY in the appropriate lines in Column B. Compare the dollar amounts entered for each FY and grand totals in both columns. If there are differences in the amounts, you will need to readjust your planned procurement/installation schedule or negotiate with the budgeting personnel for approval of a more suitable funding profile.

DECISION X
CBT Affordability

1. CBT-Related Resources

Estimated Costs:

1. Equipment _____ (Total # CBT Stations) x _____ ($2,500 (low estimate) or $5,000 (high estimate)) = _____ (Hardware Costs)

2. Software _____

3. Instructional Development _____ (CBT Hours) x _____ (Cost of Developing) = _____ (Cost to Develop)

4. Facility Modification _____

5. System Maintenance _____ (Hard/Software Courseware) x .05 = _____ (Maintenance Cost/One Year)

6. Total Maint. Cost _____ (Total Maint. Cost) = _____ (Maintenance Cost/One Year) X _____ (# of Years)

7. Total System Cost = _____

8. Cost Distribution

Fiscal Year Cost Chart

	1st FY__	2nd FY__	3rd FY__	4th FY__
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____
5	_____	_____	_____	_____
Sub-Total	_____	_____	_____	_____

9. Funds Comparison

	Column A	Column B
1st FY_____ -	_____	_____
2nd FY_____ -	_____	_____
3rd FY_____ -	_____	_____
4th FY_____ -	_____	_____
Grand Total	_____	_____

DECISION X
CBT Affordability

Interpretation

Worksheet X is designed to assist you in making decisions concerning CBT affordability. From the information assembled and displayed through the worksheet, you should be able to realistically view the costs of needed resources both incrementally and as a whole distributed over an acceptable timeframe. You should also be able to compare this desired distribution with known funding availability and make appropriate adjustments.

CBT-Related Resources

An essential factor to consider when deciding whether CBT is affordable is the cost associated with resources needed to implement and support CBT. These resources usually consist of equipment, software, instructional development, facility upgrade modification, and system maintenance. Worksheets used earlier have assisted in the definition of these resources and their estimated costs as they relate directly to training needs. You are asked to consolidate these estimates at this point in order to view them in terms of total cost and affordability. This information forms the basis for further planning.

Cost Distribution

Once total and incremental costs are determined, you must decide when specific resources require acquisition and funding. For example, you may decide that CBT implementation will occur in timed phases calling for only a portion of the total equipment to be on hand during the first half of a given fiscal year. Additionally, any modification or upgrade to a facility may not be necessary for a year or more. You must decide during which fiscal year's funds need to be committed to ensure timely receipt of products and services. You are asked to distribute the costs according to the planned schedule of implementation events and subtotal each affected fiscal year.

Funds Comparison

With funding requirements distributed according to a desired schedule, you must determine if adequate funds can be made available to support the schedule. This is usually accomplished by you in coordination with the funding agency. Once the funding availability is known, its distribution can be compared with the desired schedule. In instances where amount and availability of funds do not adequately support the planned requirements, you must rethink the plan and make adjustments to the schedule, if possible. Your goal is to match available funding with your requirements in a common timeframe. Achievement of this goal indicates minimum affordability.

CONCLUSION

Now that you have completed the CBT Planning, Selection, and Implementation Guidelines, you have assembled most of the information which you will need to properly plan for CBT; select the CBT system which suits your organization's needs; and implement that CBT system with minimal problems and disruption of your training program. Much of the information which you have gathered and provided in response to the Questionnaire, and the results of your use of that information in making the various decisions in the Guidelines, must now be put into a usable form depending on what you are going to do. There are four common scenarios into which the majority of new CBT projects fit. Pick the one which best suits your organization, and read that part of this section to determine how you should make use of the information gathered here. The rest of this section is divided into four parts to match the four possible scenarios depicted below:

A. If you plan to develop CBT *in-house*, and *use existing* equipment and software.

B. If you plan to develop CBT *in-house*, and *acquire new* equipment and/or software.

C. If you plan to *contract* for the development of CBT, but *use existing* equipment and software.

D. If you plan to *contract* for the development of CBT, and *acquire new* equipment and/or software.

[Note: You should select one of the scenarios described above which best suit your organization. Proceed directly to that section to determine how to make use of the data from these Guidelines.]

SCENARIO A.

For those organizations planning to develop CBT *in-house*, and *use existing* equipment and software.

If this scenario fits your organization, you will not need to develop any specifications to acquire supplies or services. You should have completed Decisions A through D. These decisions provide information which is critical to the CBT planning process. If your organization's CBT implementation plan is not based on the training requirements, and does not take into account the needs of your students and staff, you can significantly increase your potential for failure.

Several of the Guidelines decisions will provide you useful information; however, since you have elected to make use of existing CBT software and equipment, you may not need to make use of all of this information during the CBT planning process or for the selection of CBT equipment and software. The following decisions may be considered to provide optional information for organizations which fit this scenario:

H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W

[Note: Although these decisions are classified as *optional*, you must determine if they may be applicable to your organization's needs. Much of the information which you have provided in these sections should have gone into your decision to use the existing equipment and software because it is compatible with your training requirements. If your decision was based on factors other that determinations made through the algorithms provided by this document, you will need to be quite careful in not making use of the information in these decisions.]

The following decisions will provide you with the information that you will need right now to determine how CBT will affect the organization.

E Your CBT development staff will need to consider the type of CBT technology required. Decisions H through L which depend on the results of Decision E should be considered if changes to existing equipment or software are necessary.

F This information should have been used to determine your organization's ability to develop CBT *in-house*. If there are staff deficiencies identified by this decision, you should take the appropriate steps to correct those deficiencies now during the planning process.

G Your organization's ability to maintain its CBT system, including hardware, software and courseware must be considered during the planning process.

X Although this decision is less important to you than if you were planning to

contract the development of the CBT courseware, or acquire new equipment or software, it still should be taken into consideration in assessing the overall impact of the new CBT on the organization. As you know, the time of military and civilian personnel also represents a cost to the organization. If these personnel are being used to develop CBT, they cannot be used to perform other duties.

Since your organization plans to utilize current resources and perform its own courseware development work, there is no need to develop a specification for the acquisition of either services or equipment. This document should serve as your CBT development plan throughout the CBT project. Keep the data in the document current and this file can serve as a collection point for all information regarding CBT in your organization.

STOP HERE. YOU ARE FINISHED WITH THE GUIDELINES.

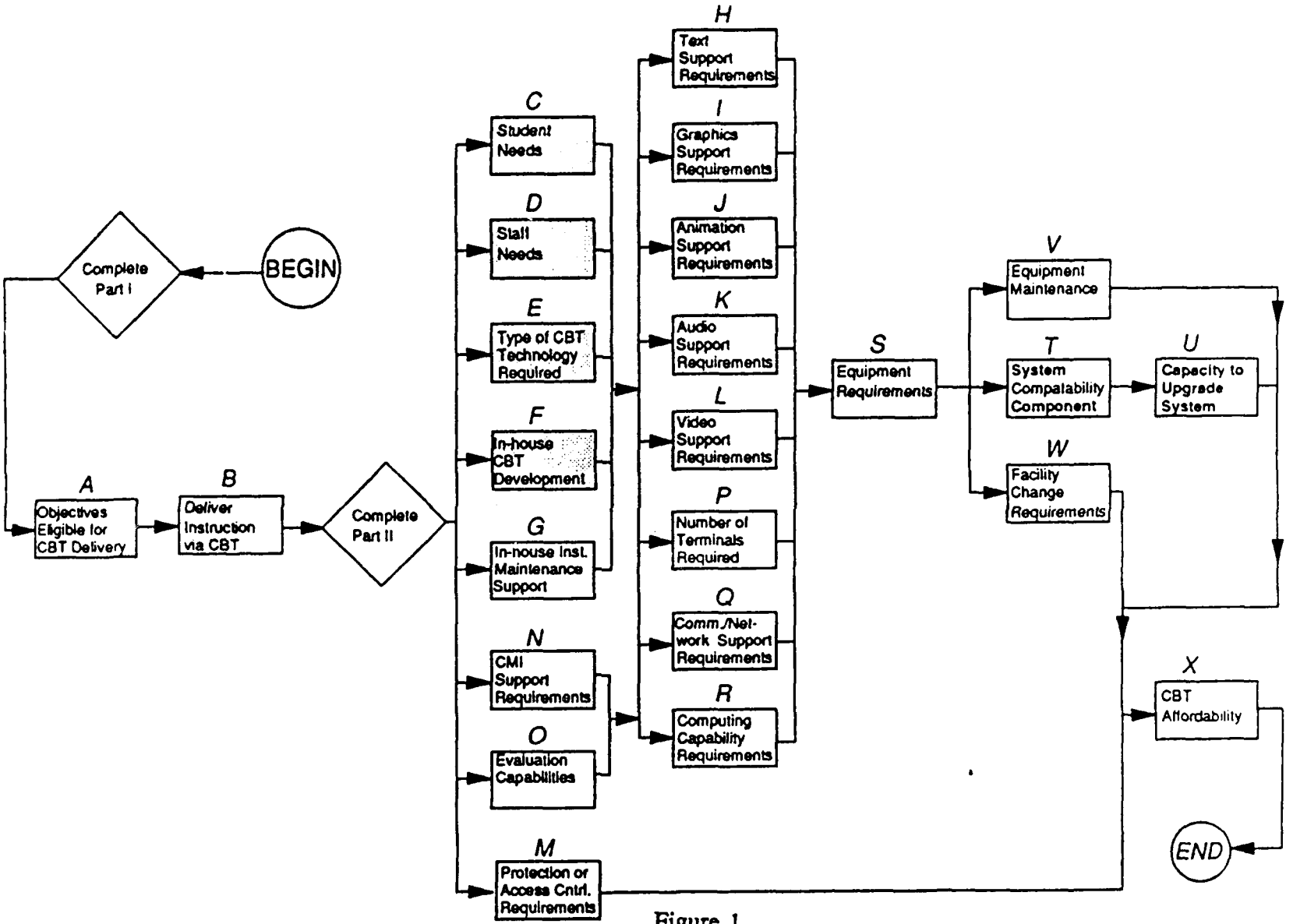


Figure 1

GUIDELINES ROADMAP

for Scenario A

Developing CBT In-House using Existing Equipment

SCENARIO B.

For those organizations planning to develop CBT *in-house*, and *acquire new* equipment and/or software.

You should have completed Decisions A through D. These decisions provide information which is critical to the CBT planning process. If your organization's CBT implementation plan is not based on the training requirements, and does not take into account the needs of your students and staff, you can significantly increase your potential for failure.

If this scenario fits your organization, you will need to develop some type of specification for the acquisition of any CBT equipment which you identified as needed in the Guidelines. You may also have to develop a specification for the selection and acquisition of a CBT authoring system. Most of the information for either of these specifications has been gathered together in these Guidelines. Look through the rest of this section to determine what you will need to do with all of the data that you have here.

E Your CBT development staff will need to consider the type of CBT technology required. Decisions H through L, which depend on the results of Decision E, should be reviewed if changes to existing equipment or software might be necessary.

F This information should have been used to determine your organization's ability to develop CBT *in-house*. If there are staff deficiencies identified by this decision, you should take the appropriate steps to correct those deficiencies now during the planning process.

G Your organization's ability to maintain its CBT system, including hardware, software and courseware must be considered during the planning process. You will need to take steps to ensure that there is a CBT courseware maintenance staff available after the development effort is over.

In developing a specification for the acquisition of equipment (either computers, monitors, videodisc players, printers, or other devices), you will need to include data from the following decisions. If a specification is not required for the acquisition of the equipment, you should make use of the information in these decisions to use as a checklist in evaluating the hardware for suitability, i.e., match the capabilities of various equipment against your requirements to determine if the hardware meets the need.

I, K, L, P, Q, R, S, T, U

In developing a specification for the acquisition of software (either networking, authoring systems, or other software), you will need to include data from the following decisions. If a specification is not required for the acquisition of the software, you should make use of the

information in these decisions to use as a checklist in evaluating software for suitability, i.e., match the capabilities of various software against your requirements to determine if the software meets the need.

H, I, J, K, L, M, N, O, Q, T

Several of the Guidelines decisions will provide you useful information; however, you may not need to make use of all of this information during the CBT planning process. The following decisions may be considered to provide optional information for organizations which fit this scenario:

W If you are acquiring equipment, you will need to determine whether existing facilities are capable of handling the new and/or additional equipment. This decision will provide information on those factors which should be taken into account.

X Although this decision is less important to you than if you were planning to contract the development of the CBT courseware, it still should be taken into consideration in assessing the overall impact of the new CBT on the organization. As you know, the time of military and civilian personnel also represents a cost to the organization. If these personnel are being used to develop CBT, they cannot be used to perform other duties.

Since your organization plans to perform its own courseware development work, there is no need to develop a specification for the acquisition of these services. This document should serve as your CBT development plan throughout the CBT project. Keep the data in the document current and this file can serve as a collection point for all information regarding CBT in your organization.

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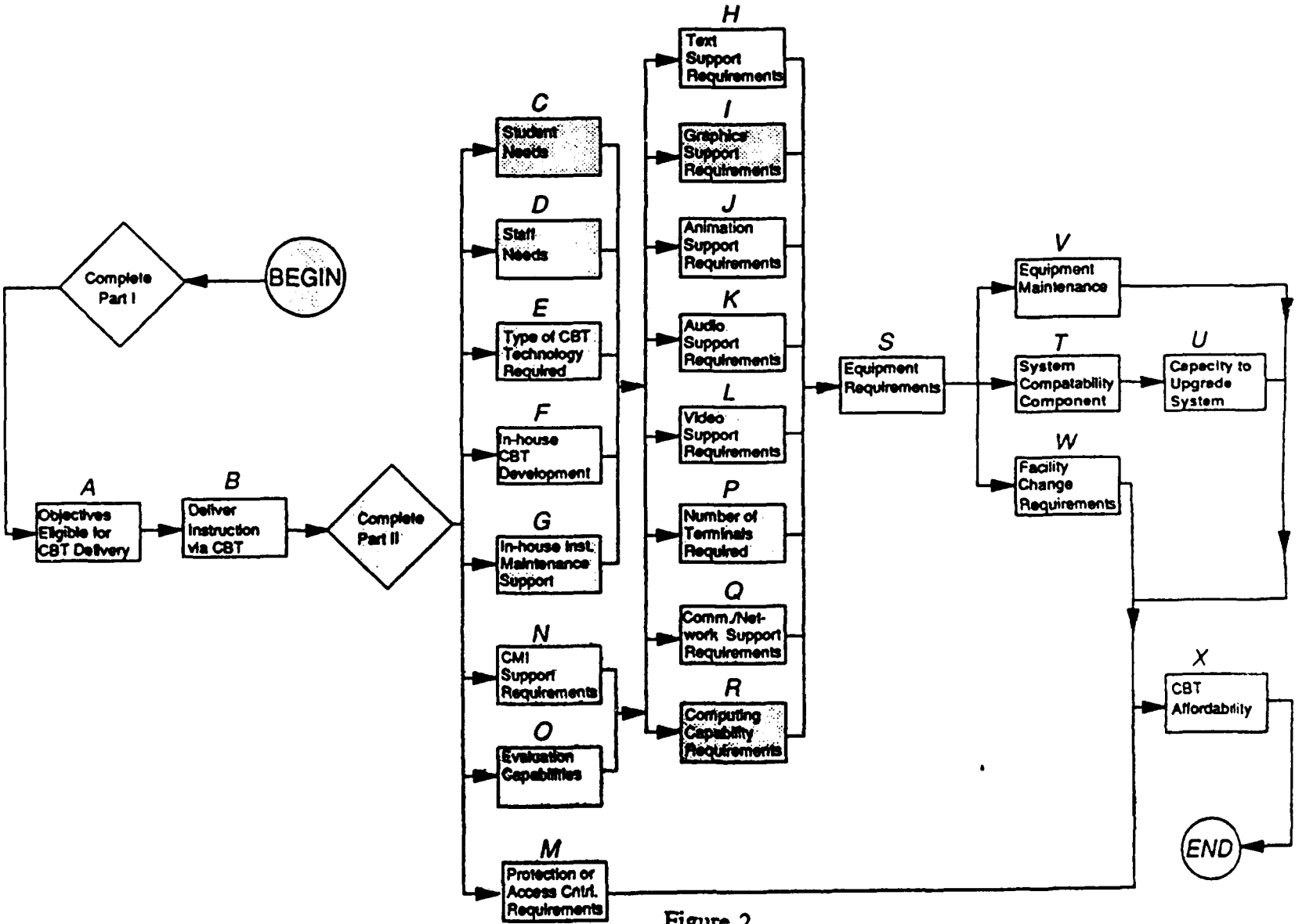

Figure 2

GUIDELINES ROADMAP

for Scenario B

Developing CBT In-House Acquiring New Equipment

SCENARIO C.

For those organizations planning to *contract* for the development of CBT, but *use existing* equipment and software.

If this scenario fits your organization, you will not need to develop any specifications to acquire CBT equipment and software. You should have completed Decisions A through D. These decisions provide information which is critical to the CBT planning process. If your organization's CBT implementation plan is not based on the training requirements, and does not take into account the needs of your students and staff, you can significantly increase your potential for failure.

Several of the Guidelines decisions will provide you useful information; however, since you have elected to make use of existing CBT software and equipment, you may not need to make use of all of this information during the CBT planning process or for the selection of CBT equipment and software. The following decisions may be considered to provide optional information for organizations which fit this scenario:

M, P, Q, R, S, T, U, V, W

[Note: Although these decisions are classified as *optional*, you must determine if they may be applicable to your organization's needs. Much of the information which you have provided in these sections should have gone into your decision to use the existing equipment and software because it is compatible with your training requirements. If your decision was based on factors other that determinations made through the algorithms provided by this document, you will need to be quite careful in not making use of the information in these decisions.]

In developing a specification (and statement of work) for the development of CBT courseware, you will need to make use of the information contained in the following decisions. This information will be used to describe for the contractor the kind of students you will be training; the existing CBT platform (computers and software) which will be used; the specific objectives for the CBT lessons which are to be developed; the type of CBT technology expected; and some characteristics of the lessons.

A, B, C, E, H, I, J, K, L

The following decisions will provide you with the information that you will need right now to determine how CBT will affect the organization.

X This is a critical decision because you are planning to contract the development of the CBT courseware. The costs associated with the development effort have been estimated in this decision. The figure which you arrived at there is not an exact figure, but can be used by you for planning purposes. Obviously, the final

bid which you receive from the contractor based on the requirements of the CBT specification (which include all of the information contained in the decisions listed above) will be the amount of money which you will need to complete the CBT development.

You should maintain all of the information developed by your organization in this document. The document will provide a useful tool in planning CBT until you have completed your CBT development specification. Whether you issue a Request For Proposals (RFP) for the work, or provide a statement of work to some contractor already under contract, this document will be useful for the organization throughout the entire CBT planning and selection process.

STOP HERE. YOU ARE FINISHED WITH THE GUIDELINES.

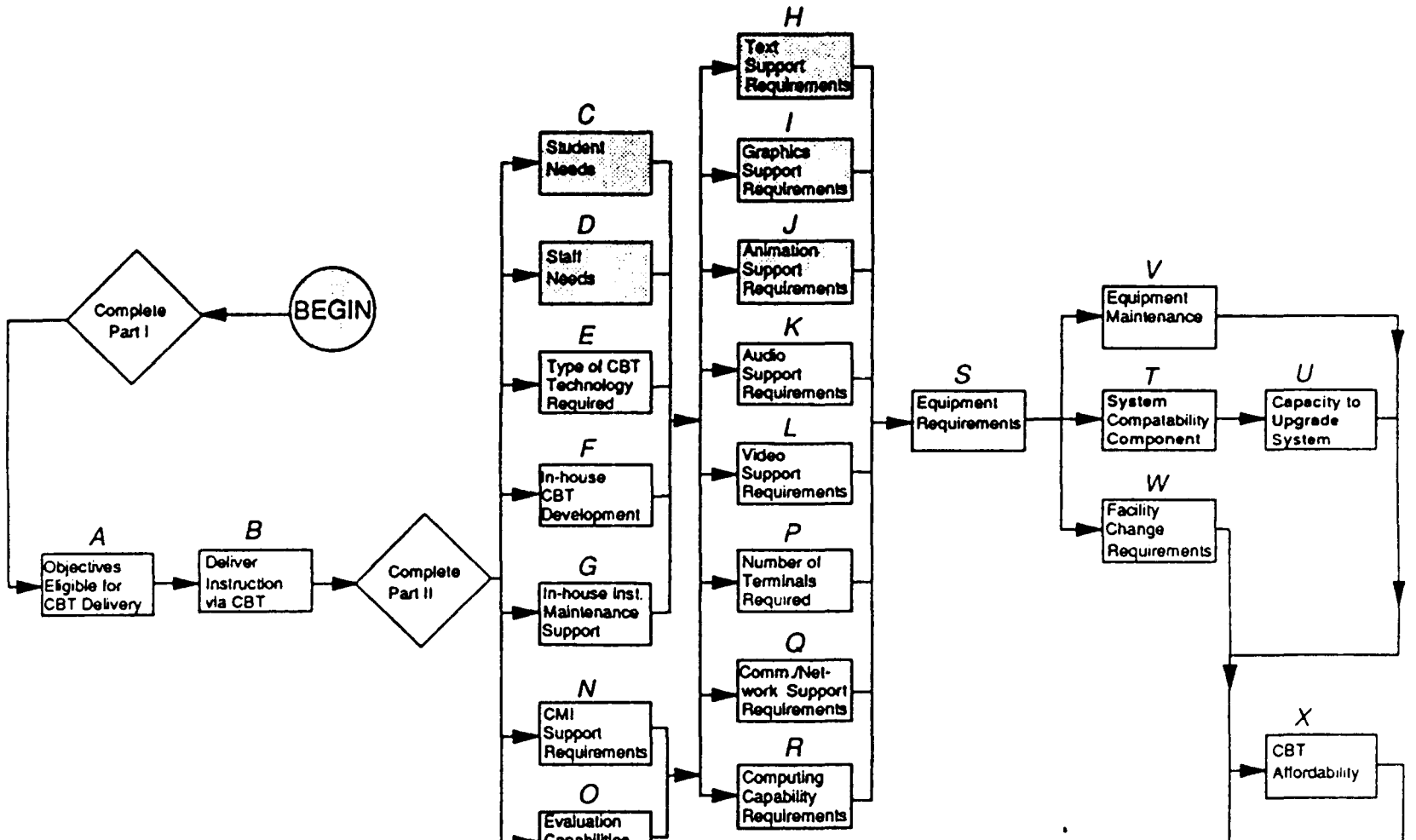

Figure 3

GUIDELINES ROADMAP

for Scenario C

Contract for the Development of CBT Using Existing Equipment

SCENARIO D.

For those organizations planning to *contract* for the development of CBT, and *acquire new* equipment and/or software.

If this scenario fits your organization, you will need to develop specifications for CBT courseware development and for CBT equipment and software. Most of the information which you will need for the development of these specifications is contained in this document.

In developing a specification (and statement of work) for the development of CBT courseware, you will need to make use of the information contained in the following decisions. This information will be used to describe for the contractor the kind of students you will be training; the kind of CBT platform (computers and software) which will be used; the specific objectives for the CBT lessons which are to be developed; the type of CBT technology expected; and some characteristics of the lessons.

A, B, C, E, H, I, J, K, L

In developing a specification for the acquisition of equipment (either computers, monitors, videodisc players, printers, or other devices), you will need to include data from the following decisions. The information in these decisions will be used by the vendors to configure their equipment for a bid, and by the contracting officer to evaluate the hardware for suitability, i.e., match the capabilities of various equipment against your requirements to determine if the hardware meets the need.

I, K, L, P, Q, R, S, T, U

In developing a specification for the acquisition of software (either networking, authoring systems, or other software), you will need to include data from the following decisions. The information in these decisions will be used by the software or authoring system vendors to configure their software for a bid, and by the contracting officer to evaluate the software for suitability, i.e., match the functions of various software against your requirements to determine if the software meets the need.

H, I, J, K, L, M, N, O, Q, T

The following decisions will provide you with the information that you will need right now to determine how CBT will affect the organization.

W Since you are acquiring equipment, you will need to determine whether existing facilities are capable of handling the new and/or additional equipment. This decision will provide information on those factors which should be taken into account. If you will expect the contractor to modify the facilities to accommodate

the installation of the new CBT equipment, you will need to include most of this information in the specification.

X This is a critical decision because you are planning to contract the development of the CBT courseware, and acquire CBT hardware and software. The costs associated with the development effort, the equipment, and the software have been estimated in this decision. The figure which you arrived at there is not an exact figure, but can be used by you for planning purposes. Obviously, the final bid which you receive from the contractor based on the requirements of the CBT specification (which include all of the information contained in the decisions listed above) will be the amount of money which you will need to complete the CBT development.

You should maintain all of the information developed by your organization in this document. The document will provide a useful tool in planning CBT until you have completed your CBT hardware, software, and development specifications. Whether you issue a Request For Proposals (RFP) for the work, or provide a statement of work to some contractor already under contract, this document will be useful for the organization throughout the entire CBT planning and selection process.

STOP HERE. YOU ARE FINISHED WITH THE GUIDELINES.

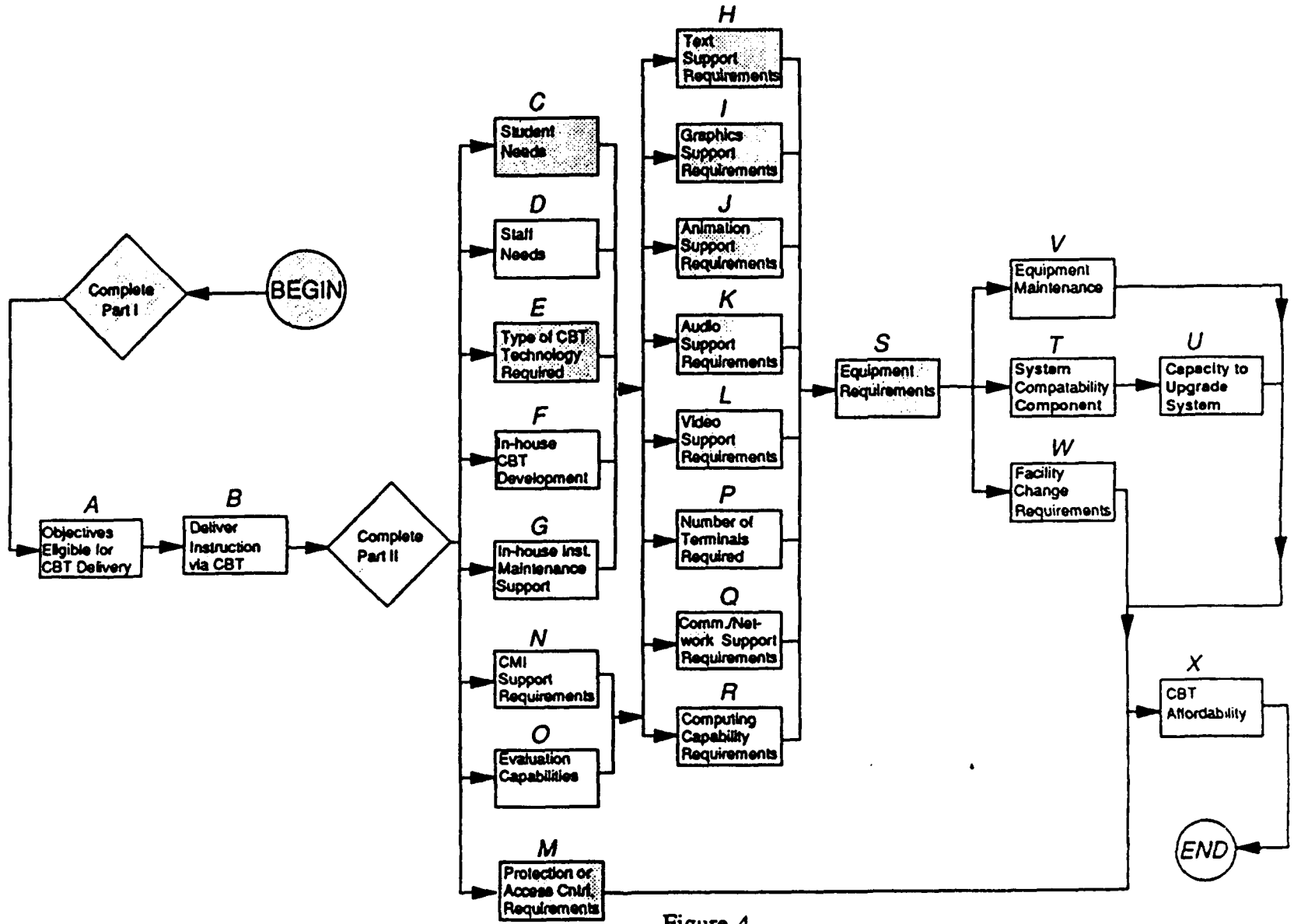

Figure 4

GUIDELINES ROADMAP

for Scenario D

Contract for the Development of CBT and Acquire New Equipment

Part I

Questionnaire

Questionnaire Instructions

In answering the following questions, please indicate your response clearly by circling or writing in the one best answer, unless directed otherwise. Don't hesitate to rely upon course documents or other staff members to complete the questionnaire. It is important that each question be answered thoughtfully and completely.

1: How frequently is this instruction provided?

a. Monthly

b. Quarterly

c. Semi-annually

d. Annually

2: What is the estimated average number of times (events) per year some type of courseware maintenance is performed?

_____ times (events) per year

3: What is the average number of instructional hours receiving some type of courseware maintenance each time (each event) it is performed?

_____ instructional hours

4: How would you characterize a typical student's previous experience with computers?

a. No previous experience.

b. Limited experience. Student has used the computer before for CBT, or for simple applications.

c. Regular experience. Student uses the computer regularly for one to two types of tasks, such as word processing, data bases, etc.

d. Extensive experience. Student has used the computer for several different types of tasks and can easily learn to use it for new tasks.

One aspect of a course is its level of standardization, meaning the degree of similarity in the method of presentation, the supplemental student materials used, the nature of the content, and the type of performance assessment across a cross-section of classes. For the purposes of this Questionnaire, the term "highly standardized" is defined to mean that identical methods are employed across a group of classes that share one objective and the term "not standardized" is defined to mean that different means (delivery method, course materials, or media) are used to achieve that objective.

5: On a scale from one to five, with one being "not at all standardized" and five being "highly standardized," how standardized is the content of the instruction across classes?

Not at all		Somewhat		Highly
1	2	3	4	5

6: Using the same scale (one = not at all standardized; five = highly standardized) how standardized is the delivery method, the course materials, and the media used across classes held at the same training center for the same objective?

Not at all		Somewhat		Highly
1	2	3	4	5

7: Are there any parts of the curriculum that are optional to the student, that is, optional objectives?

a. Yes

b. No

8: Are there any plans to change the current objectives?

EX: consolidation of objectives, changing the scope of the objectives, resequencing objectives

a. Yes, and these changes will occur in _____ (number) of weeks/months (circle one).

b. No plans to change the current objectives.

9: What type(s) of equipment or machinery is used as part of this instruction? (Circle all that apply.)

a. Operational equipment

b. Simulators

c. Part-task trainers

d. Model

e. Other (please specify)

_____

_____

f. None

10: When the focus of the objective is on the development of a specific skill, practice frequently plays a key role. Do most of the skill building or practice-type objectives in this course require equipment?

a. Yes - most of the practice-type objectives used in this course require equipment as follows: (Circle or write in all that apply)

1. Operational equipment
2. Simulators
3. Part-task trainers
4. Models
5. Other_____

b. No - The skill building objectives in this course do not require equipment.

c. There are no skill building or practice-type objectives in this course.

11: Do you have plans for acquiring new training systems (simulators, part-task trainers, etc.) or new training technology?

a. Yes

b. No

12: Is the student required to perform under any unusual environmental conditions, for instance, in total darkness or in a certain atmospheric pressure?

a. Yes

b. No

For the purposes of this document, the term performance standard refers to the minimum acceptable level of performance. For example, a student might be required to respond within a specified time frame, to a certain level or within a range of accuracy.

13: What types of standards do these course objectives require? (Circle all that apply.)

a. Time

b. Speed

c. Distance

d. Angle or degree

e. Percentage accurate

f. + or - value

The next four questions ask about the training approaches that are currently being used in this course.

14: Is any portion of the course taught using formal on-the-job training?

a. Yes

b. No

15: At some formal schools, an environment is created that replicates the conditions found on-the-job. In this type of training, the student is placed in a facility much like that found in the field, but without the performance and/or production pressures. This is called vestibule training. Is this method used?

a. Yes

b. No

16: Is any part of the course taught out in the field, such as in a field training detachment?

a. Yes

b. No

17: Is any type of formalized assistantship or apprenticeship training used?

a. Yes

b. No

18: What types of training settings are used in this course? (Circle all that apply.)

a. Classroom

b. Simulator

c. Laboratory

19. If the laboratory setting is used in this course, is equipment provided in the lab?

a. Yes, equipment is provided in the lab

b. No, equipment is <u>not</u> provided in the lab

c. The laboratory setting is <u>not</u> used in this course

20. Are there plans to expand or improve the use of simulators or part-task trainers that alter the student's learning environment?

a. Yes, there are plans to expand or improve their use.

b. No. There are no plans to expand on their use.

c. Media such a simulators or part-task trainers are not used.

21: Are cutaway or mockup/model exhibits used to support the objectives?

a. Yes

b. No

22: How is the equipment and/or exhibits(s) used in the teaching situation?

a. Demonstration only

b. Hands-on

c. Both demonstration and hands-on

23: Are there any other devices or pieces of equipment used that haven't been discussed?

a. Yes

b. No

24: Are there plans to change the use of graphics, exhibits, or projected images in this course?

a. Yes

b. No

The following three questions probe the ways that knowledges and/or skills are taught or the instructional methods currently used in this course. This refers to the actions the instructor takes to help students learn the material and meet the objectives. Answer the questions in terms of what usually occurs in a typical running of the course with an average number of students. The following table contains a listing of several types of instructional methods that are used in the classroom. Please use these definitions when completing the questions. Take a few moments to review this table before continuing.

Instructional Delivery Methods	
Method	**Definition**
Lecture	A formal or semiformal oral presentation of information either directly by a single instructor or presented indirectly (as in a recording)
Discussion	An instructor-controlled interactive process of sharing information and experiences related to achieving a training objective
Demonstration	Presentation or portrayal of a sequence of events to show a procedure, technique or operation; usually accompanied by an oral explanation; may be direct or indirect
Self-study	A student-controlled instructional process whereby the student is responsible for obtaining the information necessary to achieve the training requirements from sources provided or suggested by an instructional monitor
Indirect Discourse	Verbal interaction among two or more people which is heard by the students; may be a dramatization, such as role playing or a dialogue between panel members
Assigned Reading	Printed verbal materials such as books, T.O.'s, vendor manuals, handouts; reading may be course assigned or suggested reading
Teaching Interview	Question and answer session between the instructor and a visiting "expert" following a highly structured plan
Questioning	An instructor-controlled interactive process used to emphasize a point, stimulate thinking, keep students alert, check understanding or review material
Programmed Questioning	An instructor-controlled interactive process used to systematically demand a sequence of appropriate student responses
Student Query	The provision by which students are given the opportunity to search for information, as by questioning a classroom instructor, tutor or coach
Seminar	A peer-controlled group interactive process in which task- or objective-related information and experience are evoked from the students
Performance	Student interactions with equipment, data, persons, or any other thing, as necessary, to attain training objectives; includes all types of simulators, part task trainers, or actual job materials
Case Study	A carefully designed description of a program situation, written specifically to provide systematic analysis and discussion

25: What type of instructional method is primarily used? (Circle the <u>one</u> best answer.)

a. Lecture
b. Discussion
c. Demonstration
d. Self-study
e. Indirect discourse
f. Assigned reading
g. Teaching interview
h. Questioning
i. Programmed questioning
j. Student query
k. Seminar
l. Performance
m. Case study

26: Are any other types used in conjunction with _____? [Fill in blank with answer to previous question.] (Circle all that apply.)

a. Lecture
b. Discussion
c. Demonstration
d. Self-study
e. Indirect discourse
f. Assigned reading
g. Teaching interview
h. Questioning
i. Programmed questioning
j. Student query
k. Seminar
l. Performance
m. Case study

27: What type(s) of instructional method(s) is/are required by the objectives? (Circle all that apply.)

a. Lecture

b. Discussion

c. Demonstration

d. Self-study

e. Indirect discourse

f. Assigned reading

g. Teaching interview

h. Questioning

i. Programmed questioning

j. Student query

k. Seminar

l. Performance

m. Case study

28: Can students master the objectives by reading, listening or watching the material?

a. Yes

b. No

29: Is it necessary for learners to be able to formulate, ask, and obtain a response to their questions?

a. Yes

b. No

30: In some instances, students may be evaluated based on the quality of their "live" interaction with either the instructor or other students (such as interpersonal communications training). How many instructional hours require this type of interaction?

____ _____ hours

31. Are there secondary goals of the course which require high instructor involvement (e.g., orientation to military life, modeling of instructor behavior)?

a. Yes

b. No

Please STOP here.

Refer to Vol. 1, Decision A.

Part II

Questionnaire

Questionnaire Instructions

In answering the following questions, please indicate your response clearly by circling or writing in the one best answer, unless directed otherwise. Don't hesitate to rely upon course documents or other staff members to complete the Questionnaire. It is important that each question be answered thoughtfully and completely.

Student Profile

Administrative/Management

This section contains questions about the proposed CBT program, trained personnel requirements and some of the future needs and plans for this program.

32: What is the student's typical age?

_____ years

33: What is the student's typical rank or grade?

_____

34: What is the typical educational background of the student?

a. GED

b. High school only

c. Some college

d. Bachelor's degree

e. Master's degree

f. Doctorate

35: Is student motivation for the course considered low, medium, or high?

a. Low

b. Medium

c. High

36: To what degree will incoming students vary in background and previous training?

a. Great variance

b. Some variance

c. Little variance

37: Do you foresee any changes to the current student profile?

a. Yes

b. No

38: How many students will typically use CBT each year?

_____ students

39: What will be the average number of students in each class?

_____ students per class

40: How many students will be using CBT at any given time?

_____ students at a time

41: What length of time (in days) will the student have access to CBT?

_____ days

42: How many hours per day do you anticipate the proposed CBT system being used?

_____ hours/day

43: If the CBT system will be used by multiple classes, how many classes will be using CBT at any one time?

_____ classes at a time

44: If the CBT will be used by multiple classes, how many students will be in each class using CBT at any one time?

_____ students/class

45: What type of existing computer equipment will be used as part of the proposed CBT system? (Circle all that apply.)

a. Mainframe

b. Minicomputer

c. Microcomputer (PC)

d. Storage devices (floppy disk drives, hard disk, tape drive, optical storage devices)

e. Input devices (keyboard, joy stick, mouse, bit pad, etc.)

f. Monitor(s)

g. Printers

h. Other (please specify) _____

_____

_____

i. None

46: What type of software programs currently in use will be used with the proposed system? (Circle all that apply.)

a. Authoring System

b. Courseware delivery

c. Graphics package

d. Animation package

e. Word processing

f. Spreadsheet

g. Data Base

h. Flow chart package

i. Statistical package

j. Utility package

k. Other (please specify)

_____

l. None

47: What resources will be shared with other systems? (Circle all that apply.)

a. Courseware

b. Authoring system

c. Computer processing time

d. Storage or memory

e. CMI data

f. None - no requirement exists

48: For those sites that will share capabilities, where are they located in relation to the proposed location of this CBT system?

a. Same classroom

b. Same building

c. Same training center, but different building

d. Off base location, e.g., different base

e. Not applicable

49: Where will system maintenance facilities, including courseware, course management, operating system, and hardware, reside? On-site (e.g., in-house or vendor) or remote (e.g., vendor or other purchased support)?

a. On-site

b. Remote

50: Will the vendor need access to the CBT system?

a. Yes

b. No

Instructional Requirements

The next group of questions, although fairly diverse, focus on the instructional or training requirements mandated by the objectives. As you consider each question, concentrate on the conditions, behaviors and performance standards dictated by those objectives selected for CBT.

51: Do any of the objectives require very sophisticated (life-like or job-like) simulations?

EX: troubleshooting, war games, mission scenarios, gaming, role playing

a. Yes

b. No

52: Will the students need an opportunity to practice procedures or solve problems in realistic situations?

EX: scenarios, simulations, gaming

a. Yes

b. No

53: Do the training requirements dictate that students work together as a group or team to achieve any of these objectives?

a. Yes

b. No

54: Do any of the objectives require that the students share a simulation or courseware, for example, mission scenarios or war games?

a. Yes

b. No

55: Will it be necessary for the instructor to electronically monitor the students' progress through a lesson? For instance, will the instructor need to "listen-in" to the student during a CBT lesson?

a. Yes

b. No

56: Will it be necessary for the instructor to send electronic messages (scores, remediation hints, announcements, reminders) to the students before, during, or after the CBT lessons?

a. Yes

b. No

Evaluation Format

This section is concerned with the types of evaluation that will be used to assess student knowledge during or following instruction. Keep in mind the performance standards and the behavior which is being assessed when you answer these items.

57: What type(s) of evaluation will be used in the CBT course? (Circle all that apply.)

a. Written: generally used to measure knowledge-based behaviors (e.g., analyze, classify, determine, identify, locate, predict, select, state, or verify)

b. Oral: used to measure behaviors requiring speech

c. Performance: generally used to measure skills (e.g., adjust, align, calibrate, demonstrate, install, operate, perform, repair, etc.)

d. Simulation: used to assess the student's ability to recognize decision points and to determine the proper action to take in certain situations which approximate the job environment.

58: What type(s) of written questions do you plan to use in the proposed CBT system? (Circle all that apply.)

a. Multiple choice

b. True/false

c. Matching

d. Short answer

e. Fill-in-the-blank

f. Essay

59: If the type of written questions you plan to use in the proposed CBT system is open-ended (e.g., short answer, fill-in-the-blank, constructed response, or essay), is it necessary for the student to answer these questions with the EXACT terminology, spelling, punctuation, and case, or are variations acceptable?

a. Variations acceptable

b. EXACT terminology needed

c. No plan to use open-ended questions

60: If variations in terminology, spelling, punctuation, and case for open-ended questions are acceptable, what types of variations are acceptable?

a. Spelling

b. Synonyms

c. Spacing

d. Punctuation

e. Abbreviations

f. Upper or lower case

61: What type(s) of immediate performance feedback is necessary for students to receive? (Circle all that apply.)

a. Correct/incorrect

b. Prompt/hint

c. Response specific guidance/explanation

d. Immediate student performance feedback is not necessary

Visual/Audio Requirements

The following set of questions is still focussed on the training requirements. However, the key issue here is how the instructional information should be presented to the student. Please consider the underlying tasks, the supporting information, and the abstractness of the concepts being presented when responding.

Text Requirements

62: What different types of textual features will this instruction utilize? Include those you are using now. (Circle all that apply.)

a. Different type styles (fonts) (e.g., Roman, Helvetica, Italics, etc.)

b. Different type sizes (10, 12, 14 point, etc.)

c. Underlining

d. Bolding (highlighting)

e. Blinking (If you use this on films or videotape now)

f. Different colors

g. Other (please specify) _____

h. None

63: What special types of characters or symbols will this instruction require? Include those you are using now. (Circle all that apply.)

a. Mathematical symbols

b. Schematic symbols

c. Engineering character set

d. Scientific character set

e. Programming language character set

f. Foreign language character set

Specify language _____

g. Other (please specify) _____

64: Are visual aids required for the student to learn the material or to perform the task?

a. Yes

b. No

65: What types of graphic images are required by the objectives? (Circle all that apply.)

a. Tables

b. Charts or forms

c. Diagrams

d. Equipment (including aircraft, parts, weapons, etc.)

e. Equipment panels (including dials, gauges, switches, etc.)

f. Uniforms/Personal gear

g. Human figures

h. Geographical information (aerial maps, runway designations, flight paths, etc.)

i. None

66: Do the objectives selected for CBT require or very life-like graphic images?

EX: exhibits, models, equipment, uniforms, human figures, geographical information

a. Yes

b. No

67: Will the graphic images need to be in color?

a. Yes

b. No

c. There is no requirement for color images.

68: Will printed copies of the graphic images be necessary?

a. Yes

b. No

69: Will the printed copies of graphic images need to be in color?

a. Yes

b. No

c. There is no requirement for printed copies of graphic images.

70: The need for changes in graphic image support are

a. anticipated and should be implemented in _____ (numbers) weeks/months (Circle one.)

b. not anticipated at this time

Animation

Often, complex or abstract principles are more effectively presented in animated form. For instance, the concept of missile trajectory may be more readily understood if the student can see the impact of changing the angle of presentation, the weight of the missile and the speed at which it travels.

71: Do any of the objectives slated for CBT rely upon abstractions that lend themselves to animated graphic images?

EX: flow of fluid through a system, principles of physics, equipment operation

a. Yes

b. No

72: How would you describe the complexity of the graphic images which you plan to animate?

a. Complex (e.g., equipment panels, human figures, terrain maps)

b. Simple (e.g., line drawings, stick figures, geometrical shapes)

c. Not applicable

73: Will you need to be able to animate several images simultaneously (e.g., to show several dials or gauges changing at once)?

a. Yes

b. No

c. Not applicable

74: For those objectives slated for CBT which lend themselves to animation, how important is it for the motion in the animations to be smooth (i.e., not jerky)?

a. Very important (e.g., animated sequences must have the look and feel of their real-life counterparts)

b. Moderate importance (e.g., only the depiction of motion itself is important)

c. Not applicable

75: In order for the students to grasp the concepts depicted by these animated figures, will color graphic images be necessary?

a. Yes

b. No

76: Is the need for or reliance upon animation expected to change?

a. Yes, and the change will occur in _____(number) of weeks/months (circle one).

b. No

74: For those objectives slated for CBT which lend themselves to animation, how important is it for the motion in the animations to be smooth (i.e., not jerky)?

a. Very important (e.g., animated sequences must have the look and feel of their real-life counterparts)

b. Moderate importance (e.g., only the depiction of motion itself is important)

c. Not applicable

75: In order for the students to grasp the concepts depicted by these animated figures, will color graphic images be necessary?

a. Yes

b. No

76: Is the need for or reliance upon animation expected to change?

a. Yes, and the change will occur in _____(number) of weeks/months (circle one).

b. No

Video

80: Are any still images required for the instruction?

EX: photographs, slides, filmstrips, maps

a. Yes

b. No

81: If still images are required for the instruction, will they need to be very detailed or life-like?

a. Yes

b. No

c. There is no requirement for still images in the instruction.

82: Will still images required to be very detailed or life-like need to be in color?

a. Yes

b. No

c. There is no requirement for very detailed or life-like still images.

83: Will these images need to be supported by textual material or sound?

a. Textual material only

b. Sound presentation only

c. Both text and sound presentation

d. Neither text nor sound

84: Will this still video require simultaneous graphics or animation presentation?

a. Graphics presentation only

b. Animation presentation only

c. Graphics and animation presentation

d. Neither graphics nor animation

85: Will there be a need to produce a hard copy of these still video images requiring simultaneous graphics or animation presentation?

a. Yes

b. No

86: Do these printouts of still video images requiring simultaneous graphics or animation presentation need to be in color?

a. Yes

b. No

c. There is no requirement to produce hard copies of still video images requiring simultaneous graphics or animation presentation.

87: Are the requirements for high resolution, high fidelity images expected to change?

a. Yes, and the changes are expected to occur in _____ (number) of weeks/months (circle one)

b. No

88: Is any motion video support required to teach these objectives?

EX: film, videotape, laserdisc

a. Yes

b. No

89: Will any required motion video presentation need to be realistic, motion picture-quality images?

a. Yes

b. No

c. No motion video support will be required.

90: The required motion video will be supplemented with which of the following?

a. Textual material only

b. Sound presentation only

c. Both text and sound presentation

d. Neither text nor sound

e. No motion video will be required.

91: This motion video will require which of the following?

a. Graphics presentation only

b. Animation presentation only

c. Graphics and animation presentation

d. Neither graphics nor animation

e. No motion video is required

92: Does the video need to be in color in order to achieve the objective?

a. Yes

b. No

93: Are changes foreseen in the need for audio or video support?

a. Yes, and these changes will take place in _____ (number) of weeks/months (circle one).

b. No

94: Does the instruction require that instructional events occur within a particular timeframe, that is, real-time?

a. Yes

b. No

95: Does the instruction require that time intervals be measured in any way? For example, are the students required to respond to a question or perform an action within a certain time interval?

a. Yes

b. No

96: Do any of the objectives require that the student access or respond to the system within the same real-time constraints they will experience on-the-job?

a. Yes

b. No

97: Do any of the objectives require the development of eye-hand coordination, or will eye-hand coordination tasks be used to facilitate the achievement of an objective?

a. Yes

b. No

98: Do the objectives require the student to perform manipulative tasks that can be taught in a simulated setting, for example, "turning" dial, "setting" switches, etc.?

a. Yes

b. No

Student/Course Management Issues

The following questions deal with record keeping, scheduling and report generation and how these needs should interface with the proposed CBT system.

99: What individual student record information would you like to maintain on the computer? (Circle all that apply.)

a. Lesson grades
b. Block grades
c. Course grades
d. Previous course grades
e. Current assignments
f. Future assignments
g. Completed assignments
h. Skills progress checks
i. Student counseling reports
j. Duration of lesson session
k. Time on individual screens
l. Length of time to complete test(s)
m. Performance on individual questions
n. Number of attempts (individual questions)
o. Student responses to individual questions
p. Number of times student has taken course
q. Bookmark of where student is in lesson
r. Demographics (name, rank, i.d., AFSC)
s. There is no need to keep individual student records on the computer

100: What class records are to be maintained on the computer? (Circle all that apply.)

a. Average lesson grades
b. Average block grades
c. Average course grades
d. Current assignments
e. Number of students in class/group
f. Average time in lesson
g. Average time in testing
h. Performance on individual test items
i. No class records are to be maintained on the computer

101: Will any of the students or class records to be maintained include records and/or data compiled off-site?

a. Yes

b. No

c. No student or class records will be maintained on the computer.

102: Will the student or class records from off-site be compiled using the same CMI package that is planned for use with the proposed CBT system?

a. Yes

b. No

c. No off-site student or class records will be maintained on the computer.

103: How long is it necessary to maintain the student or class records? (If records are not to be maintained on computer, circle "Not applicable.")

a. 0-6 months

b. 6-12 months

c. 1-2 years

d. More than two years

e. Not applicable

104: How often are the student or class records accessed? (Circle all that apply.) (If records are not to be maintained on computer, circle "Not applicable.")

a. Daily

b. Weekly

c. Monthly

d. Quarterly

e. Annually

f. Only on a need-to-know basis

g. Not applicable

105: What type of statistical information or analysis will be computed and maintained? (Circle all that apply.)

a. Test item analysis data

b. Course validation and/or evaluation data

c. Test averages/means

d. Standard deviations

e. Test score medians and/or modes

f. Performance curves

g. None. There is no need to compute and maintain statistical information.

106: Will the raw data used in these calculations include student response data from remote or off-site training locations?

a. Yes

b. No

107: Will the raw student data from remote or of-site training locations be collected using the same CMI package as that planned for use with the proposed CBT system?

a. Yes

b. No

c. Not applicable

108: What type of reports will the system need to generate? (Circle all that apply.)

a. Student progress

b. Student evaluation

c. Computer utilization rates/time

d. None

109: Will the record keeping required for the system-generated reports need to be centralized?

a. Yes

b. No

c. There will be no need for the system to generate reports.

CBT System Developers

The questions in this section of the inventory focus on the CBT system developers, that is, the instructors, courseware developers, and training managers.

Courseware Development Personnel

110: Which of the following CBT design and development activities have your staff participated in? (Circle all that apply.) Include only if performed in the context of CBT development effort.

a. Task analysis

b. Objective(s) development

c. Developing outlines/lesson specifications

d. Storyboarding

e. Lesson review and revision

f. Personnel on my staff have no experience in CBT design and development.

111: How many of your CBT experienced personnel will be available to work full time in courseware development or revision activities? (Answer in terms of man-years of effort per year; fractions are acceptable.)

EX: If five personnel are available to participate in courseware development or revision activities 100 percent of the time for one year, the number of man-years is five. However, if the five personnel can only devote one-half of their work time to the development/revision effort, the number of man-years is 2.5 (5 X .5 = 2.5).

a. _____ man-years/year

b. Personnel on my staff are not at all experienced in CBT courseware development, design or revision.

112: Which languages or authoring systems do your computer programming or courseware authoring staff have experience with? (Circle all that apply.)

a. ISS/AIS-II

b. Quest

c. Phoenix

d. PILOT

e. Saber

f. TICCIT

g. BASIC

h. C

i. FORTRAN

j. Pascal

k. Other (please specify)

_____

_____

l. My staff members are not experienced in computer programming or courseware authoring.

113: How many of your experienced personnel will be available to work on computer programming or courseware authoring activities? (Answer in terms of man-years of effort per year; fractions are acceptable.)

EX: If five personnel are available to participate in computer programming or courseware authoring activities 100 percent of the time for one year, the number of man years is five. However, if the five personnel can only devote one-half of their work time to the programming and authoring effort, the number of man-years is 2.5 (5 X .5 = 2.5).

a. _____ man-years/year

b. My staff members are not experienced in computer programming or courseware authoring.

114: Which of the following activities have your personnel with video production experience participated in? (Circle all that apply.)

a. Storyboarding/scripting shots or scenes

b. Camera operation

c. Directing

d. Editing

e. My staff members are not experienced in video production.

115: How many of your personnel who are experienced with video production will be available to work full time in CBT-related video development activities? (Answer in terms of man-years of effort per year; fractions are acceptable.)

EX: If five personnel are available to participate in CBT-related video development activities 100 percent of the time for one year, the number of man-years is five. However, if the five personnel can only devote one-half of their work time to the development effort, the number of man-years is 2.5 (5 X .5 = 2.5).

a. _____ man-years/year

b. My staff members are not experienced in video production.

116: What types of graphics production media have your personnel used? (Circle all that apply.)

a. Drawing/line art

b. Photography

c. Computer graphics development

d. Computer animation development

e. My staff members do not have graphics production experience.

117: How many of your personnel who are experienced with graphics production will be available to work full time in CBT-related graphics development? (Answer in terms of man-years of effort per year; fractions are acceptable.)

EX: If five personnel are available to participate in CBT-related graphics development 100 percent of the time for one year, the number of man-years is five. However, if the five personnel can only devote one-half of their work time to the development effort, the number of man-years is 2.5 (5 X .5 = 2.5).

a. _____ man-years/year

b. My staff members are not experienced in graphics production.

118: What type of experience does your staff have with computer systems? (Circle all that apply.)

a. Purchasing computers

b. Setting up individual computers (micros or minis)

c. Setting up or administering a local area network (LAN)

d. Troubleshooting or maintaining in-house computers

e. Configuring a facility for computers (multiple micros or a single large computer)

f. My staff does not have experience in purchasing, setting up, or trouble shooting computer systems equipment.

119: How many of your personnel who have experience with purchasing, setting up, and troubleshooting computer systems equipment will be available to work full time in CBT installation or maintenance? (Answer in terms of man-years of effort per year; fractions are acceptable.)

EX: If five personnel are available to participate in CBT installation or maintenance 100 percent of the time for one year, the number of man-years is five. However, if the five personnel can only devote one-half of their work time to the installation/maintenance effort, the number of man-years is 2.5 (5 X .5 = 2.5).

a. _____ man-years/year

b. My staff does not have experience in purchasing, setting up, and troubleshooting computer systems equipment

120: Do you currently have an equipment maintenance contract in effect?

a. Yes

b. No

121: Which of the following activities have your personnel with experience in managing CBT development projects participated in?

a. Managing in-house all phases of CBT development efforts

b. Managing major portions of CBT development

c. Managing a small portion of CBT development effort

d. My staff does not have experience in managing CBT development projects

122: How many of your personnel who have experience in managing CBT development projects will be available to work full time in a CBT development effort? (Answer in terms of man-years of effort per year; fraction are acceptable.)

EX: If five personnel are available to participate in CBT development 100 percent of the time for one year, the number of man-years is <u>five</u>. However, if five personnel can only devote one-half of their work time to the development effort, the number of man-years is <u>2.5</u> (5 X .5 = 2.5).

a. _____ man-years/year

b. My staff does not have experience in managing CBT development projects.

123: How would you characterize a typical staff member's previous experience with computers?

a. No previous experience.

b. Limited experience. Has used the computer before for CBT or for simple applications.

c. Regular experience. Uses the computer regularly for one to two types of tasks, such as word processing, data bases, etc.

d. Extensive experience. Has used the computer for several types of tasks, and can easily learn to use it for new tasks.

Please STOP here.

Refer to Vol. 1, Decision C.

SUPPLEMENTARY

INFORMATION

Audio

77: What type of audio support is required for the objectives selected for CBT? (Circle all that apply.)

a. Oral narration

b. Sound or language recognition (radio communications, foreign language, audio signals, etc.)

c. Oral communication development (speaking foreign language or jargon, issuing orders, etc.)

d. Intelligent voice interaction ("conversation" between student and computer, e.g., radio communications, conversational foreign language)

e. There are no objectives requiring the use of audio.

78: Which of the following supplements the required audio? (Circle all that apply.)

a. Textual material

b. Graphic images

c. Animation

d. No audio support is required.

e. Audio support is required but it is not supplemented with any verbal or written instruction, graphics display, or animated sequence.

79: Are changes in the requirements for audio support envisioned?

a. Yes, and these changes will be implemented in _____ (number) of weeks/months (circle one)

b. No